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## Journal of Transport &amp; Health

journal homepage: <http://www.elsevier.com/locate/jth>

## Small cities, big needs: Urban transport planning in cities of developing countries

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## ARTICLE INFO

## Keywords:

Citizen-centred policy  
Urban and transport planning  
Healthy and sustainable cities

## ABSTRACT

Cities in developing countries face acute pressures due to increased motorization, urbanization and growing population. Urban transport planning systems can fuel healthy cities, yet research examining the interface between policies and needs in Africa remains scarce. A mixed-methods approach was used to assess the alignment between urban transport policies and self-reported citizens' needs in Port Louis city (Mauritius). Logistic regression models were run to detect associations between needs and demographic indicators (age, gender, income). Three policy measures were assessed: light metro rail system, bus modernization scheme and road decongestion program. Six citizen needs and six mode of transit preferences were extracted from 1523 surveys (N). Citizens reported the need for improving sidewalks (80%), public spaces (77%), green spaces (67%), pedestrianizing strategic areas (66%), centralizing street-vendors at bus stations (57%) and regulating private vehicles entry in town (40%). The policies addressed 3 out of 6 needs, of which all were more likely to be expressed by poorer population groups. The policies did not respond to citizen needs for active modes of travel. They did not address health and social co-benefits of transport. Rather they emphasized an economic agenda focused on transport infrastructure as opposed to policy reforms in line with public needs that much more strongly highlight the integration of urban transport planning in social life. Citizen-centred approaches provide a unique opportunity to reform urban transport planning policies towards more healthy and equitable cities in developing countries.

**Abbreviations:** LMIC, Low- and Middle-Income Country; NDS, National Development Strategy; MUR, Mauritius Rupee; LRT, Light Rail Transit System.

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<https://doi.org/10.1016/j.jth.2020.100944>

Received 27 January 2020; Received in revised form 2 August 2020; Accepted 1 September 2020

Available online 11 September 2020

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## 1. Introduction

Urban transport planning systems play a critical role in fostering healthy and sustainable cities. By 2050, 66% of the world's population will live in cities requiring a serious consideration of the role of transport and its impact on the liveability of people and planet (Stoett et al., 2019). From a public health perspective, drastic increase of motorization leads to more traffic deaths and injuries, more exposure to air pollution and noise and less physical activity (Khreis et al., 2016). The case of developing countries, also referred to as low and middle income countries (LMICs) for the purpose of this paper is particularly alarming. Pressure is rising with 90% of growing urban populations predicted to settle in Asia and Africa by 2050 (Nations, 2014). Already, LMICs disproportionately claim 92% of the 7 million global deaths related to air pollution exposure (World Health Organization, 2016). They absorb 90% of 1.25 million traffic-related deaths despite owning only 47% of the world's registered vehicles (Adeloye et al., 2016; Organization, 2015). Increased motorization also triggers sedentary lifestyles contributing to the rise of non-communicable diseases in urban areas. This phenomena is also inequitably affecting the globe with 80% of 56.9 million NCD-related deaths per year occurring in LMICs (Alwan, 2011).

Scientific literature from high income countries show that citizen-centred approaches in the sector of urban and transport planning is a potential solution to achieving more liveable cities, and spaces that respond to citizen needs and aspirations (Mandeli, 2019; Lusk et al., 2018; Dierwechter and Coffey, 2010; Verlinghieri, 2019; Smith, 2017). For instance, practicing citizen participation in urban transport planning policy is crucial to boost governance processes, increase cost-efficiency and creative problem solving (Le Pira et al., 2016). Collecting citizen preferences is also useful to identify and design infrastructure most likely to support and encourage healthy active travel modes such as walking and cycling (Lusk et al., 2018). Yet, studies on citizen-centred urban transport planning and health impact of transport policies in developing countries is lacking (Jones et al., 2016; Bartels et al., 2016).

Some evidence shows that cities in sub-Saharan Africa are struggling to deploy transport strategies that comply with global trend standards; i.e. encouraging more sustainable and compact cities, healthy living practices and environmental awareness (Sietchiping et al., 2012). Rather, cities such as Lagos, Douala and Nairobi are promoting motorization and growing to be more car-dependent in contradiction with, and at the expense of, urban populations that primarily walk and cycle for social and economic reasons (Sietchiping et al., 2012). This phenomenon is contextual to cities of the developing world and represents a real paradox in the use of urban space. Indeed, studies from Cameroun to India show that urban transport policy and planning are not responding to growing citizen needs demand for transport modes other than the car (Ouongo, 2010; Conti and Mahendra, 2014). The fact that commercial and industrial activities remain concentrated in central area where traffic congestion has become the norm and that large-scale road infrastructure projects are deployed to address congestion in countries like Kenya (Kinney et al., 2011), may be one of many reasons car-centric measures overpower policies that may be directed at other transport modes. Hence, the resulting clash between policy measures and citizen needs trigger complex issues such as alarming levels of congestion, increased air and noise pollution, and traffic danger; all of which threaten human health and social equity.

It is crucial to explore urban transport policy measures in cities already facing high burden of mortality, morbidity and inequity. This paper assesses the alignment, if any, of three government policy measures with citizen needs in an African setting, Port Louis the capital city of Mauritius. The main objective is to examine the extent to which policy measures address citizen needs. The specific objectives are to (Stoett et al., 2019): assess selected policy measures (Khreis et al., 2016), assess self-reported needs of citizens in a nationwide survey (Nations, 2014), examine the alignment of existing policy measures with citizen needs and (World Health Organization, 2016) identify what population groups are most likely to be affected possible misalignments. The paper concludes on the health and social benefits that can result from applying citizen-centred lens to the assessment and design of urban transport planning policy in cities of low and middle-income countries.

### 1.1. Theoretical arguments from literature

The role of transport in developing urban areas has become an ever more important part of city life. Economic growth has resulted in a rapid increase in vehicular traffic (Runji, 2015). As urbanization grows, urban lifestyles combine with urban layouts and build environments to create ever-growing travel needs, both in frequency and travelled distances (Thynell et al., 2010). As LMIC's concentrate some of the higher rates of urbanization and motorization growth in the world, they are in dire need of rapid transportation planning if they want to provide the necessary transport infrastructure to meet the growing demands (Godard, 2013). The process of planning transport in the midst of a motorization and urban demographic growth is a challenging proposition, and one that affluent and well-planned cities around the world have struggled with. While LMIC transportation policies tend to mirror those developed by developed countries, several important differences exist among their respective paths towards modern and sustainable transportation systems. In most cases, LMIC transport policies face the need to tackle both the increase in demand and the need to provide sustainable transportation services. Most transport systems in the developed world were built in an age where no criteria of sustainability other than the economic dimension existed. It has been only recently that they have been charged with the responsibility to convert those systems into social and environmental sustainability. Current LMIC's transportation policies aim at not only meeting demand, but doing so in a sustainable way. As pointed by Thynell et al. (2010) this endeavour in LMIC can be even more challenging when compared with high income countries. The population of LMIC's is often more socioeconomically diverse than that of developed countries, creating a much more complex map of needs, preferences and possibilities than more homogenised societies. The local transport situation is often also more complex, with an important role of paratransit transport. Having a multiplicity of vehicle ownership arrangement, wider diversity of vehicle types, speeds and street-uses increases policy complexity.

The different local cultures of planning can also impact both the planning process and the expected outcome. The political regime

its openness and tradition can result in planners having more or less freedom to exercise their skills, whether for good or ill, more accountability towards local citizens or larger degrees of participation (Friedmann, 2005). Similarly, the fact that planners usually are part of a professional middle class, tend to skew transport policies toward the needs of their class, which tend to be different from the lower classes (Sietchiping et al., 2012). This often results in increased investment in road schemes, and large infrastructure plans that often neglect the smaller and more detailed oriented needs of lay citizens. While urban and spatial planning development is increasing in most LMIC cities, in terms of transportation planning, consideration for transport options other than the car are seldom given attention (Sietchiping et al., 2012). This situation often leads to the paradox of large investments on road and rail infrastructure under a modernizing master plan in a society where the large majority of people would have benefit from cheaper investments oriented towards walking and cycling.

A common issue in both LMIC and high income countries regarding transportation planning is the salient disconnection between land use planning and transportation planning (Hickman et al., 2013). It is often that transportation solutions have to wrestle with non-existent urban development limits or sprawl inducing land use practices. One could argue that in rapidly urbanising societies, land use planning has a bigger impact on transportation options than transportation planning itself. The examples of Lagos, Johannesburg or Cairo show how difficult it is to manage mobility and transport once sprawl has already occurred (Sietchiping et al., 2012). On the other hand, containing sprawl, investing in transit-oriented development and limiting new urban expansion to compact, mixed and dense developments can facilitate transportation plans, allowing for more and better options and avoiding car-dependency.

New transportation policy developed in the LMIC can encounter struggles in each key elements of effective transportation policies: setting the policy objectives, designing the strategies, and monitoring and evaluating the results. Policy objectives often revolve around using better transport and accessibility to achieve economic growth, health and poverty reduction. At this level however, planners may suffer from bias towards hard-infrastructure projects, road investment and lack of attention to small-scale needs for improvement. When designing strategies for implementation, drawbacks can concentrate either at the design or the implementation phase. The failures in the design process can arise when strategies don't align with either policy objectives or citizen's needs. On the implementation stage, the African Transport Policy Performance Review (Runji, 2015) highlights some major drawbacks that can be extended to most LMICs: inadequate human resources capacity, affordability of transport strategies, lack of information and information systems, or inadequate investment prioritizing framework. Finally, several challenges often arise on the monitoring and evaluation phase. There is a general lack of feedback after the strategies have been implemented, due to data limitations, poor data quality or low human resources to actually manage and analyse the gathered data.

Overall, the accumulation of biases and drawbacks in the planning process can end up creating transport policies that are not properly aligned with citizen's needs. Given the essential role that transport plays at contributing to citizen's capacity to participate in work opportunities as well as also to fulfil their daily domestic needs (Sietchiping et al., 2012), this misalignment can have huge consequences for everyday life and social equity (Lau, 1997). Particularly worrisome is the general direction of most LMIC transport policies towards increased motorization and car-dependency which sets a path towards perceived modernization through the building of new road infrastructure. These set of strategies however are designed with no attention to the real needs of citizens (Porter et al., 2012), often accustomed to meeting their travel needs through a complex network of active and informal modes of transport (Godard, 2013).

The misalignment between modern transport projects, though and built by and for middle-high classes clashes with the everyday mobility of a majority of population that relies on other forms of transport. This misalignment can induce further differences in accessibility, even making it harder for some population groups to access their basic needs within the city. According to Lucas (2011), social exclusion through transport poverty is an overwhelming problem in developing countries. Transport poverty can arise from a lack of provision of transport infrastructure, from having to spend too much time in transport or having to spend too much time away from home so one cannot undertake all the necessary life-supporting activities (Porter, 2002). Hence, the main objective of this paper is to assess the alignment of transport policy measures with citizens needs in Port Louis (Mauritius) by using a mixed-methods triangulation approach.

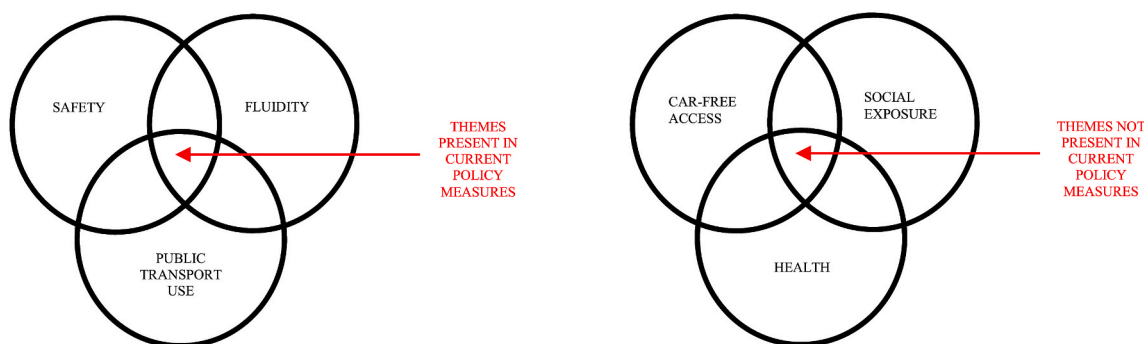


Fig. 1. Study framework.

## 2. Material and methods

A mixed-methods triangulation approach was used to examine transport policy measures and assess whether they align with citizen needs in Port Louis city (Fig. 1). The Annual Report of the Ministry of Public Infrastructure and Land Transport (Ministry of Public Infrass, 2017) a key policy document on urban transport planning in Mauritius, was analysed qualitatively in order to select and examine relevant policy measures. The citizen needs assessment was conducted using an existing set of data resulting from a national survey entitled 'Map mo Port Louis'. The access to this data was granted by the authority and organization who conducted the survey between August and December 2016. The survey investigated citizen perceptions, needs and preferences on urban development in Port Louis. Logistic regression models were run for each need to detect associations between demographic indicators and citizen needs.

### 2.1. Study setting and relevance

Mauritius is a small island developing state (SID) located in sub-Saharan East Africa and is the continent's most densely populated country (653 persons per square kilometre) (World Bank, 2013; Government of Mauritius, 2015). The prevalence of non-communicable diseases has been rising dramatically over the last decade with a current 15% prevalence of diabetes and 30% prevalence of hypertension in adult population aged between 20 and 74 years old (31). Similar to other developing nations, urban population rates in Mauritius have practically doubled in the last fifty years. Because people have moved closer to urban areas for better economic and social opportunities, it is estimated that 60% of the population is stacked on only 8% of the available land. This trend creates a number of urban and transport planning challenges which are particular to fast developing countries, such as urban sprawl, traffic congestion, inadequate planning, increase in vehicle ownership and deteriorating transport infrastructure and services (16).

Although 98% of roads are paved in Mauritius, road accidents and traffic congestion are a rising issue, costing the nation approximately MUR 4 billion (\$119.6 million) per year (Ministry of Public Infrass, 2017). The motorization rate has grown rapidly over the last decades with a national vehicle fleet estimated to have increased by 625% between 1972 and 2000 (OECD, 2014). In 2018, there was 4% increase in road traffic accidents per year with an average fatality index of 4.9 per 100 casualties (Table 1). Yet, there are no policies to restrict traffic growth in Mauritius and fiscal policy related to private motorization does not exist (33). Even though UNEP has established that 90% of urban air pollution in rapidly growing cities in developing countries is attributable to motor vehicle emissions (34), there are no urban transport planning policies aiming at fuel economy and reduction of greenhouse gas emissions specifically on the island (Ministry of Social Security, 2014).

In terms of infrastructural development, the National Development Strategy (NDS) is the most relevant policy addressing traffic congestion and transport planning (Ministry of Housing and Lands G of M, 2014) (Ministry of Housing and Lands G of M, 2014). It aims to optimize the use of transport infrastructure towards a more compact pattern of development, with high concentration of people (36). Transport policies designed under the objectives of the NDS aim to (Stoett et al., 2019) promote strategic growth clusters in places with higher accessibility, and in proximity of major highway and public transport network (Khreis et al., 2016) develop mix-uses in all growth centres by raising densities, reducing travel time and offering more options by public transport and reducing reliance on car and (Nations, 2014) support the use of urban public transport facilities and network along a linear urban corridor and optimize most sustainable transport options by encouraging the use of economic, residential and leisure clusters.

Although the government shows concerns about the island's ecosystem (a nation-wide program aiming for sustainability was proposed in 2008 but has been on hold (Baguant-Moonshiram et al., 2013)), the concepts of sustainability and health are not mentioned as part of the NDS. Currently Mauritius monitors closely different health, urban and transport targets to stay on track for the Sustainable Development Goals (Ministry of Foreign Affairs Regional Integration and International Trade, 2019), but very little is known as to whether transport policy measures derived from the principles of the NDS respond to citizen needs.

**Table 1**

Country profile, sources (Government of Mauritius, 2015; Enoch, 2003; Khadaroo and Seetanah, 2008).

Characteristics of Mauritius Island	
Population (million)	1273
Area (km <sup>2</sup> )	2040
Coastline IO (km)	177
Population density (residents/km <sup>2</sup> )	653 (most dense in Africa)
Life expectancy at birth (m/f)	71/78
Number of vehicles	492,000
Number of two-wheelers	200,000
Length of main roads	2356 km
Annual fleet vehicle increase	2.3% (estimated to 4.2% for next 5yrs)
Road accidents rate (per 100,000 population in 2016)	2397
Annual road accidents increase	4%
Casualty accidents increase	7.4%
Cars (per 100 household)	78
Motorcycle (per 100 household)	60
Public Buses (total number)	2000 (incl. 1500 private)
Bicycles (per 100 household)	No data

The study was conducted in the capital city of Mauritius, Port Louis. Despite, the city being the economic and administrative engine of the country, it is considered a highly polluted and congested city. Port Louis emits 2.9 tons of net carbon dioxide per capita, costing 0.1 billion USD every year (39). It only recycles 7% of the 6308 tons of waste generated per month (Jhingut, 2016) and is highly vulnerable to deathly flash floods (41). Divided into 8 wards, it hosts approximately 119,706 residents on 46.7 km<sup>2</sup>; it is the most densely populated locality (2563 persons per square kilometre) in the country. During peak hours, the city is choked by the influx of 201,567 commuters coming from neighbouring districts mainly using motorcycles, public buses and private vehicles. The congestion is created mainly by the use of one main access motorway (M1-M2) connecting South to North, cutting through the capital city. The motorway separates the city from the waterfront (Guttee, 2015) and complicates any possibility for integrating different transport modes on its axis (for instance bus or cycles lanes). Port Louis is a car-oriented city with poor integration of different modes of travel. The public transport system is currently being revised for improvement, pedestrian movement is limited with unsafe sidewalks and walkways, and there is a lack of green and public spaces.

## 2.2. Policy assessment and urban transport planning measures

The Annual Report of the Ministry of Public Infrastructure and Land Transport (Ministry of Public Infrast, 2017) is an open-access document published at the end of every financial year by the Ministry of Public Infrastructure Land and Transport. We extracted it online and reviewed it using qualitative methods. The review of the document involved combining elements of content analysis and thematic analysis as described in Bowen (2009) (43), to select relevant urban transport policy measures for further assessment. To conduct the selection, we applied three criteria: time (initiation period and duration), cost (budget allocated) and implementation (objectives). In order to be included in the final assessment, the policy measure had to span over 3 years or more, cost the government more than 100 million MUR (approx. 2,8 million USD) and had to be currently under implementation. The criteria were developed by the main author based on the local policy timeframe (each government mandate lasts 3 years) and economic landscape of the country. We also identified the agencies involved in designing and responsible for implementing the policies (Table 2).

## 2.3. Citizen needs survey

Citizen needs were extracted from the 2016 national survey entitled 'Map mo Port Louis', ran online using an electronic data collection tool (<http://www.maptionnaire.com/1600>). The survey adopted a participatory approach to investigate citizens' perceptions on urban development in Port Louis. These included residents and non-residents of the capital. The first author (MT) designed the survey jointly with different stakeholders: public officials, NGO officers and interested citizen groups. In order to ensure that hard-to-reach groups were also included, fieldworkers were deployed in different areas of the capital in order to collect data face-to-face (using the same online electronic data collection tool). The face-to-face data was automatically added to the dataset retrieved from the online process. The data was collected online and face-to-face between June and December 2016. The sample was statistically representative of the Mauritian population, consisting of proportional distribution of participants by gender, age group and main professional categories (Table 3). For the purpose of this paper, we focused on the sections of the survey addressing urban transport planning topics only (see supplementary file A). The consideration of urban transport planning questions and answers led to the identification 6 needs and 6 preferences (Table 4) self-reported by the study sample.

## 2.4. Data analysis

### 2.4.1. Policy analysis

The policy assessment was conducted using the Atlas. ti software (Mandeli, 2019). The policy document was analysed to select the urban and transport policy measures satisfying the eligibility criteria set for the paper. Each selected policy measure was then examined in depth using the method of inductive thematic analysis relevant for qualitative research (Smith, 2015). The coding consisted of generating labels that identified features of policy measure responding to the research question. We then identified potential themes by looking at the codes across data extracts and subsequently analysed each theme.

### 2.4.2. Citizen survey analysis

The citizen survey data was analysed using the R Studio software (1.1.463). The 6 citizen needs were categorized into urban

**Table 2**  
Summary of measures.

Project name	Responsible agency	Objectives	Initiation period	Duration	Budget
Road safety strategic plan	Traffic Management and Road Safety Unit	Reduce the number of fatal and serious injury crashes through infrastructural changes and road devices	Since May 2016	5 years	MUR 600 million
Bus Modernization Scheme	National Transport Corporation	Bus fleet renewal, subsidy allocations to bus operators, and modernization of bus stops	Since June 2017	3 years	MUR 100 million
Metro Express	Mauritius Metro Express Company	A 26 km light rail transit system passing through five major cities. It features, 19 stations and air-conditioned trams accommodating 300–400 passengers.	Since March 2017	3 years	MUR 18.8 billion

**Table 3**  
Sample profile.

Gender	N	%	Professional status	N	%
female	678	46.86	unemployed	242	15.32
male	749	51.76	manual workers	285	18.04
non-disclosed	20	1.38	technicians	326	20.63
N missing	133		retired	77	4.87
Age groups	N	%	seasonal visitors	11	0.7
12–15	138	9.52	office workers	294	18.61
16–18	158	10.9	student	345	21.84
19–24	172	11.87	Income group	N	%
25–29	180	12.42	5000 or less	235	14.87
30–34	162	11.18	5001–10000	212	13.42
35–39	146	10.08	10,001–15000	161	10.19
40–49	178	12.28	15,001–25000	196	12.41
50–59	184	12.7	25,001–35000	145	9.18
60 or above	131	9.04	35,001–60000	143	9.05
N missing	131		above 60,000	488	30.89

**Table 4**  
Urban and transport policy measures alignment with needs (× = not addressed; ✓ = addressed; (NM) Not Met = needs that were not addressed by any of the policy measures).

Urban planning needs	Percentage of sample N (%)	Road traffic safety plan	Bus Modernization Scheme	LRT system
Improve sidewalks	80.27%	✓	×	×
Improve public spaces	76.89%	✓	×	×
Increase green spaces (NM)	66.58%	×	×	×
Mobility needs				
Pedestrianize strategic areas (NM)	66.28%	×	×	×
Centralize hawkers at bus stations	56.62%	×	✓	✓
Regulate private vehicles in town (NM)	39.46%	×	×	×
Mode of transit needs				
On foot	33.13%	×	×	×
Metro leger	26.94%	×	✓	✓
Own private vehicle	15.31%	✓	×	×
Bicycle (NM)	9.05%	×	×	×
Electric car and/or car-sharing (NM)	10.68%	×	×	×
Taxi-boat (NM)	4.90%	×	×	×

planning and mobility needs but the 6 mode of transit preferences were not subjected to sub-grouping. The survey results were reviewed by analysing responses to multiple answer questions. Citizens rated urban planning needs were assessed using a priority scale ranging from high priority to no priority at all. Citizens rated mobility needs were assessed using an agreement scale ranging from 'agree fully' to 'not agree at all' to solutions for optimizing mobility in the city. Mode of transit needs was assessed by a question prompting citizens to select one mode of transit from 6 context-sensitive options ('How would you prefer to transit through Port Louis?'). The bus option was not provided as a response because inner city public bus lines do not currently exist. Logistic regression models were then applied to detect significant association between particular needs and demographic indicators. Odds ratios and confidence intervals were calculated.

#### 2.4.3. Triangulation analysis

Finally, the method of triangulation was used to combine the findings from the policy assessment and from the citizen survey. Triangulation is the method whereby the researcher draws upon at least two sources of evidence in order to seek convergence or corroboration in data. It is used when the same phenomenon is studied by combining different methodologies and data sources (43).

### 3. Results

#### 3.1. Policy measures

Out of 9 policy measures described in the Annual Report of the Ministry of Public Infrastructure and Land Transport (Ministry of Public Infrast, 2017), three policy measures were selected and assessed following the eligibility criteria. They consist of the (Stoett et al., 2019) Road safety strategic plan (Khreis et al., 2016) Bus modernization scheme and (Nations, 2014) Metro express light rail transit (LRT) system. All three measures were derived from the National Development Strategy described in Section 1.2, and they span over 3 years or more, cost the government more than 100 million MUR per year and are currently under implementation (Table 2).

### 3.1.1. Road safety strategic plan

The Road Safety Strategic plan aims to reduce the number of fatal and serious injury crashes by 50% by 2025 and to bring down road crash fatality rate from 12 to 6 per 100,000 population (pg. 30). In addition to endorsing a road safety charter, setting up specialized teams and capacity building of officers, riders, examiners etc.- the plan has already achieved to construct and upgrade footpaths (over 1764), maintain speed cameras, install 3260 m handrails for pedestrians, installing of road crash barriers and road safety devices. The road safety strategic plan is deployed by the Traffic Management and Road Safety Unit, which is run on a yearly budget of MUR 500.2 million.

### 3.1.2. Bus modernization scheme

The Bus Modernization Scheme has the objective of renewing an aging bus fleet by providing financial support, in the form of subsidy allocation, to bus operators. It is under review at the moment to encourage the acquisition of hybrid, electric and double-decked buses (pg. 33). The government earmarked approximately a Rs100 million to this scheme at the beginning of 2017. The bus modernization scheme is being led by the National Transport Authority, a body in charge of other projects such as the amendment of road traffic regulations, construction of smart bus services (shelters and cars).

### 3.1.3. Metro express light rail transit

The metro express light rail transit (LRT) system is considered the major transport infrastructure of the current government. It is a nation-wide mass transit system branded as a 'game changer' (pg. 53) to the wider economic development of the island. The project is depicted as a vibrant public transport system provided with a modern road infrastructural network and a rejuvenated bus fleet encouraging mode shift from private cars to public transport.

## 3.2. Thematic analysis

The three measures reviewed (Table 2) are deployed by different agencies working within the framework of the National Development Scheme. The thematic analysis of the road decongestion program, the bus modernization scheme and the metro rail led to three main themes reflecting the objectives of the Ministry of Public infrastructure and land transport: the ease of traffic burden, concern for traffic safety and the use of public transport. There was no mention of strategies to reduce access to cars (example: pedestrianizing existing roads), to increase social co-benefits of transport (example: exposure to and interactions in public and green spaces) and to address environmental health risks and benefits (example: increase of active travel, reduction of transport-related air pollution) (Fig. 2).

		Road traffic safety plan	Bus Modernization Scheme	LRT system
Urban planning needs	Percentage of sample N (%)			
Improve sidewalks	80.27%	✓	✗	✗
Improve public spaces	76.89%	✓	✗	✗
Increase green spaces (NM)	66.58%	✗	✗	✗
Mobility needs				
Pedestrianize strategic areas (NM)	66.28%	✗	✗	✗
Centralize hawkers at bus stations	56.62%	✗	✓	✓
Regulate private vehicles in town (NM)	39.46%	✗	✗	✗
Mode of transit needs				
On foot	33.13%	✗	✗	✗
Metro leger	26.94%	✗	✓	✓
Own private vehicle	15.31%	✓	✗	✗
Bicycle (NM)	9.05%	✗	✗	✗
Electric car and/or car-sharing (NM)	10.68%	✗	✗	✗
Taxi-boat (NM)	4.90%	✗	✗	✗

Fig. 2. Themes extracted from current policy measures.

### 3.3. Citizen needs

The six citizen needs and six mode of transit preferences (Table 4) were extracted from 1523 citizen surveys. The six citizen needs consisted of three high priority urban planning needs: a) need to improve sidewalks, b) need for more public spaces and c) need for more green spaces. The three remaining needs consisted of mobility needs: a) need to pedestrianize strategic areas b) centralize hawkers (street vendors) at main bus stations and c) regulate the entry of vehicles into the city. The six mode of transit preferences included: walking, cycling, car-sharing/electric car rental, LRT, private vehicle and taxi boat.

#### 3.3.1. Urban planning needs

In terms of urban planning needs, the majority of the sample (80.3%) reported that improving the state of sidewalks is of high priority, followed by the need to improve public spaces (76.9%), and the need to increase green spaces (66.68%). A descriptive analysis of the sample showed that more men reported these three needs simultaneously than women. This was also the case for students compared to other professional groups (supplementary file B).

#### 3.3.2. Mobility needs

In regards to mobility needs, a proportion of 65% of the sample agreed fully to regulating private vehicle entry in the city while 55% agreed fully to centralizing hawkers (street vendors) at main bus stations instead of them selling goods on sidewalks. A smaller group of citizens (40%) agreed fully to pedestrianizing strategic areas. Approximately 26% of the sample did not agree that regulating private vehicle entry was a current need, versus 10% against hawker centralization and 6% against pedestrianizing options. A descriptive analysis of the sample showed that women reported less the need to centralize hawkers than men. Compared to other groups, professionals/technicians most reported the need to pedestrianized strategic areas in town (Table 4) (supplementary file B).

#### 3.3.3. Mode of transport preference

When referring to preferences of mode of transit, nearly 33% of the sample preferred to move on foot, followed by 27% who selected the prospective LRT system (metro express), while 15% preferred using their own private vehicle. Alternative options such as electric car and/or car-sharing and taxi-boat were less popular but were still considered by smaller share of participants. Cycling was selected as an option by 9% of the sample. Overall active modes of transport were preferred by 42% of the participants, public transport by 32%, and only 26% of participants preferred solutions based on private transport.

### 3.4. Alignment of policy measures with needs

Three policy measures were assessed for alignment with 6 citizen needs and 6 preferences. At least one (or more) of the measures addressed 3 needs (Stoett et al., 2019): improvement of sidewalks (Khreis et al., 2016), the improvement of public spaces (Nations, 2014), centralization of road vendors at main bus stations and 2 mobility preferences (Stoett et al., 2019): use of own private vehicle and (Khreis et al., 2016) travel by the LRT system. None of the measures addressed 3 needs (Stoett et al., 2019): increase of green spaces (Khreis et al., 2016), pedestrianizing of strategic areas (Nations, 2014), regulation of private vehicle entry in town and 4 preferences (Stoett et al., 2019): move by foot, bicycle (Khreis et al., 2016), move by bicycle (Nations, 2014) travel by electric car rental and/or car sharing (World Health Organization, 2016) travel by taxi-boat (Table 4). The road traffic safety plan addressed citizens need to improve sidewalks and public spaces and travel by private vehicle. The bus modernization scheme and the LRT system addressed the need to centralize hawkers at main bus stations and for citizens to travel by the LRT system.

### 3.5. Logistic regression results

A closer analysis of the data revealed an uneven distribution of needs across population groups. The logistic regression models showed significant associations between demographic indicators (age, gender, income and profession) and 6 urban planning and mobility needs (sidewalk, pedestrianizing, green spaces, etc.). On the contrary, they showed no significant associations between demographic indicators and 6 preferences for mode of transit. No test for interaction was conducted. Needs that showed statistically significant association with demographic indicators were further categorized based on whether they were unmet or met by policy measures (see supplementary file C). Further stratification was conducted by age and income, but only stratification by gender revealed statistically significant results.

#### 3.5.1. Unmet needs

We found no significant relationship between demographic indicators and the unmet need for green space. However, we found similarities in the population groups reporting the need for pedestrianizing strategic areas and regulating entry of private vehicles in town. They consisted of middle-aged groups (40–60 years old) and silver generation (over 60) (see supplementary file C for odd ratios and 95% CI). There was a difference however in gender and professional group indicators. Men and technician groups were more likely to report the need for pedestrianizing than women and other professional groups. In contrast, retired and student populations were more likely to be concerned about the regulation of private cars in town than other groups. The results from male gender stratification show that males from high-income groups, i.e. earning more than Rs. 60,000 were most likely to demand for both pedestrianizing and regulation of car entry (see supplementary file D). The results from female gender stratification show that females from younger age groups (Sietchiping et al., 2012; Ouongo, 2010; Conti and Mahendra, 2014), from both middle and high-income backgrounds and



retired women were most likely to report the need for regulating car entry in town (see supplementary file D).

### 3.5.2. Met needs

We found significant relationship between age, professional and gender indicators and the three needs addressed by policy measures (improvement of sidewalks, more public spaces, and centralization of hawkers at main bus stations). The need for more sidewalks was more likely to be expressed by low-income earners (Rs. 5000–10000) and younger citizens (Sietchiping et al., 2012; Ouongo, 2010; Conti and Mahendra, 2014). In addition to technicians and service workers, seasonal visitors were also more likely to report the need for more sidewalks. The results from female gender stratification show that females from a young but wider age group (Sietchiping et al., 2012; Ouongo, 2010; Conti and Mahendra, 2014; Kinney et al., 2011; Runji, 2015; Thynell et al., 2010; Godard, 2013; Friedmann, 2005; Hickman et al., 2013), from low-income and service level professions were more likely to report for an increase in sidewalk. There was no significant relationship between age group and need for public spaces. Yet, there were higher odds for technicians and service workers to report the need for more public spaces. Finally, we found that younger population groups (Kinney et al., 2011; Runji, 2015; Thynell et al., 2010; Godard, 2013; Friedmann, 2005; Hickman et al., 2013), men, manual workers and citizens from both middle- and high-income backgrounds were more likely to report the need for centralizing hawkers at the main bus stations. The results from male gender stratification show that men from two different age groups (young 16–18 and older 40–50) and retired men were more likely to report this particular need. In contrast, results from female gender stratification show that only young women (Kinney et al., 2011; Runji, 2015; Thynell et al., 2010; Godard, 2013; Friedmann, 2005; Hickman et al., 2013) and women manual workers are more likely to report the need for moving hawkers from the street and centralizing them at the bus stations.

## 4. Discussion

### 4.1. Summary of findings

Three policy measures extracted from the MPI annual report were selected for assessment (Stoett et al., 2019): a light metro rail system (Khreis et al., 2016), a bus modernization scheme and (Nations, 2014) a road decongestion program. A total of 6 citizen needs and 6 mobility preferences were extracted from 1523 surveys. (N). Findings show that the three measures are aligned with only 3 of the 6 citizen needs and 2 of their 6 mobility preferences (Table 4). From a thematic point of view, policy measures did not cater for reduction in car access (pedestrianizing existing roads), did not contribute to enhancing social co-benefits of transport (exposure to and interactions in public and green spaces) and did not encourage health benefits (increase of active travel, reduction of exposure to transport-related air pollution).

The policy measures satisfied citizen needs for improving sidewalks (80%), for facilitating mobility by centralizing hawkers at bus stations (77%) and for increasing public spaces (57%). The policies also responded to citizens' preference for using the light-rail system (27%) and their own private vehicle (15%) as mode of transport. We found that the needs met by policy measures were more likely to be expressed by citizens from low (Rs. 5'000–10'000) and middle (Rs. 10'000–25'000) income population groups. These needs were also more likely to be expressed by younger population groups (Sietchiping et al., 2012; Ouongo, 2010; Conti and Mahendra, 2014; Kinney et al., 2011; Runji, 2015; Thynell et al., 2010; Godard, 2013; Friedmann, 2005; Hickman et al., 2013) and by a greater diversity of professional groups (technician, service worker, seasonal visitor and manual worker).

The policy measures did not satisfy the need of citizens reporting for more green spaces (67%), pedestrianizing of strategic areas (66%), and regulating entry of private vehicles in town (39%). We found that the needs unmet by policy measures were more likely to be expressed by citizens from middle (Rs. 15'000–35'000) and high (Rs. above 60'000) income population groups. These needs were more likely to be expressed by older population groups (40-above 60) and by a lower diversity of professional groups (technician, retired and student). The policy measures did not support citizens' preference for walking as a mode of transport (33%), use of bicycle (9%, electric and/or car-sharing (11%) or taxi-boat (5%).

### 4.2. Mauritius: a relevant case study

More than 15 years ago, Enoch (2003) outlined the development of transport policy in Mauritius and concluded that expanding economic development would foster transport demand, which in turn, would increase vehicle ownership and trigger important congestion and air pollution issues (Enoch, 2003). Enoch (2003) suggests that the Government should concentrate more effort on policy formulation, planning and regulation and reduce its role as a provider of transport infrastructure and services. Our study shows that the selected policies addresses citizen needs through both policy formulation (policy to take hawkers off the streets and modernizing bus scheme) and policy implementation (measures to change transport infrastructure and services: building sidewalks and introducing an LRT). However, if the unmet needs are examined, it is clear that additional policy formulation is needed for responding to citizens' concerns about decongestion: pedestrianizing strategic areas and regulating entry of private vehicles in town. Additionally, if transport infrastructure was to be mandated, it would have to address citizen's health needs. This can be translated by adoption of more active travel modes such as walking and cycling and not passive modes such as the use of private vehicles.

The Mauritian case study confirms findings from India that gaps between transport policy and citizens needs stem mainly from technological, institutional and infrastructure measures that cater for motor vehicles instead of non-motorized modes (Badami et al., 2004). In its current form, Mauritius transportation plans follow a trend that plans for transportation, rather than accessibility (Handy, 2002) and health. By investing on road infrastructure, the transport policy is focusing on improving the way cars move from one place to another (and thereby encouraging motorized modes) but as demonstrated by our results, this only partly responds to citizen needs.

Even with an ideal transport infrastructure in place, walking in developing settings such as Mauritius is usually still the main mode of transport (El-Geneidy and Levinson, 2006; Iacono et al., 2010; Curl et al., 2011) and the one that provides better health and more equalitarian accessibility (Morar and Bertolini, 2013; Marquet and Miralles-Guasch, 2015). The lack of walking infrastructure (pedestrianizing options) is made evident by unmet citizen needs, that are clearly more focused on walking than improving the conditions for driving or public transport.

Our findings also suggest that the gap between policies and needs are caused by the misalignment of economic objectives of decision makers and social priorities of citizens. Our results show that citizens desire changes in infrastructure requiring substantial economic planning (example: improving sidewalks) that are integrated into a wider social framework of needs (example: meeting in green spaces) and imply the use of active travel modes (example: walking). Although we did not verify to what extent the current measures were based on participatory decision making, the qualitative analysis of transport measures showed that policy-makers focus on changes in transport infrastructure that are integrated into an economic, rather than a social framework of needs as per Fig. 2. For instance, the government's decision to implement the LRT system was based on the imperative to make it the game changer the island's economy. The provision of financial subsidies for bus companies and the omission of tax regulations for motorized transport are also deployed to support economic rather than social priorities. So, our study confirms a previous standpoint that in developing countries casting a balance between economic and social ventures related to transport is very challenging (53). One of the reasons being that limited public finance is limited and that improvement in sustainable transport usually comes at the expense of social investment projects. This discrepancy presents a missed opportunity in such contexts as studies from the World Bank show that investing in transport can effectively promote growth by increasing social value in cities (54).

### 4.3. Urban transport planning and social equity

The lack of transport surveys and weak understanding of mobility needs can hinder evidence-based policy making in the sector of urban transport planning in developing countries (14,19,55). So far, very few countries of Africa have conducted surveys on mobility patterns, making it difficult for planners to understand exactly how citizens move around their cities. To this date the government of Mauritius does not perform a national and periodic travel survey that could serve as a reliable data source on mobility needs and transport satisfaction. Even in the fastest developing nations like China and India, national travel surveys still do not exist; travel surveys are done at city level using different methods and indicators that are not often comparable at country level (Pucher et al., 2007).

We believe that the misalignments documented in this study may be explained by the lack of data which could inform urban planners about the needs of citizens. In the light of this constraint, planners may compensate lack of data with their own lived experiences. For instance, planners may assume that most people move as they do themselves (middle-age, educated males who move by car); hence they implement solutions that facilitating use of private vehicles and traffic lanes rather than pedestrian transits. These solutions contribute to maintain a car-dependant transportation system that in turn perpetuates structural inequities that hinder the full participation in society of some social groups, and that can even lead to social exclusion processes (Currie et al., 2009; Lyons, 2003; Mackett and Thoreau, 2015; Cass et al., 2005). The significant associations we detected between several unmet needs and vulnerable groups (such as old age and lower income indicators) threaten to fuel such exclusion patterns.

Considering the needs of vulnerable populations is one way that transport policy can influence social inequity (Martens, 2016). In our study, we found the needs more likely to be expressed by older population groups (pedestrianizing strategic areas (66%) and regulating entry of private vehicles in town (39%) were not addressed by the measures. Indeed, the current urban layout has been shaped based on the main mode of transport available. By promoting road infrastructure (highways, bridges, etc.), policies are shaping the future urban layout and morphology based on the necessities of the car (more distances, less density, more sprawl and separation between uses). In this car-oriented city, not having access to a car is much worse and creates many more social impacts than in the compact walkable city. Therefore, such policies are incomplete or inappropriate not only because they do not address the current needs but also because they are creating a city that will deepen the problems of non-car owners; for instance, older population groups.

Hence, bringing concerns of social inequity to the table are crucial to understand how urban transport planning measures are unique to their own contexts. It enables us to evaluate co-benefits for different groups and consider populations that are normally left outside the formal planning process. At the same time, it is also helpful to identify more promising patterns such as those uncovered here. As our results indicate, the improvement of sidewalks is a need met by policy measures that is more likely to be expressed by low-income earners and young populations groups (less than 18 years). Positively, it is also a need expressed by the majority of the sample (80%). Therefore, catering for better sidewalks benefits the poorer sectors of society and also has a universal positive impact throughout groups at different socioeconomic levels.

Our findings are therefore more promising than those in Indian cities where the existing urban transport infrastructure do not meet the needs the urban poor (a large proportion of city residents), whose travels are primarily dominated by walking trips, short distances, public transport and use of non-motorized modes (Tiwari, 2002). Our study also indicates that the need for public transport is met by the government deploying the LRT system which also stands in contrast with a study in Cali showing that people from low socio-economic levels and living in disadvantaged districts have less mobility opportunities due to lack of access to the public transport system (Grindlay et al., 2017). Finally, we also found that the needs met by policy measures are mostly and more likely to be expressed by women – confirming a previous study in Brazil that the improvement of infrastructure and traffic conditions adjusted for gender differences is worth being advocated for (Bacchieri and Barros, 2011). By attending to their needs, urban transport planning systems are not only considering segregated vulnerable groups but are making the situation better for the future too.

#### 4.4. Implications of the study for other cities

Our findings have implication for other cities of the developing world. First, it indicates that unless policies respond more adequately to citizen needs, social and health inequities in cities may increase (see section 4.3). Second, it shows that considering citizen insights in designing and reviewing urban transport planning policies in developing countries can be a valuable process and will benefit different population groups. It reveals that considering demographic indicators when addressing human needs is an efficient method to adapt policy making processes to the ‘local situation’ (65) (55). A study on the success of urban renewal projects in South Africa reports that the use of appropriate technologies and community-based approaches are more efficient means of satisfying community needs than approaches adopted in western, developed countries (Thwala, 2009). Our study also confirms that policies need to be planned for activities (such as street vending businesses/hawkers) that are specific to developing countries (Khayesi et al., 2010). In other parts of the world, the increasing need to consider citizen concerns is justified by frustration toward urban congestion, concern for the natural and social environment, and desire for sound public investments (Tang and Waters, 2005). In Mauritius, the analysis of citizen needs shows a strong orientation towards an urban transport planning system that promotes healthy and active lifestyle through walking (improvement of sidewalks, pedestrianizing, green space) and increase in social exposure (more public spaces). Responding to these needs not only creates a more healthy system but also makes outcomes much more sustainable due to increase in citizen “ownership” (De Weger et al., 2018). Hence, combining the concepts of health and citizen-centred planning in the context of urban transport is highly relevant.

Verlinghieri (2019) argues that citizen participation has a range of potential benefits for health and that appropriate urban and transport planning practices allow these benefits to occur (Verlinghieri, 2019). Yet, despite mounting evidence linking transport to health (Gudmundsson et al., 2016), indicators most often considered by urban transport planning technicians are restricted to road accidents, air pollution and noise pollution only (Nieuwenhuijsen et al., 2016). Therefore, complementing traditional approaches of policy making with citizen science can encourage the inclusion and consideration of wider health-related needs and impacts (Dierwechter and Coffey, 2010; Martí Costa and Pybus, 2013). Hence, we join other studies in confirming the potential for citizen-centred approaches to reform urban transport planning policies towards more healthy, sustainable and equitable outcomes (Conti and Mahendra, 2014; Tang and Waters, 2005; Chang-Hong et al., 2009; Mahendra and Rajagopalan, 2015; Dionisio et al., 2016; Kahl-Tani et al., 2016; Allen et al., 2011).

#### 4.5. Limitations

To our knowledge, this is the first study focusing on citizen needs and urban transport policy in the developing world, and more specifically in Africa. It adds value to the scientific literature on urban transport planning in LMICs by profiling needs and policies using real-time data and preferences. It is estimated that by 2030, the majority of the world’s urban residents will dwell cities of less than 500’000 residents (78). This study brings an important contribution to insufficient knowledge on how such cities work and evolve. For the sake of length, this study focuses on one policy document withholding the main policy measures currently deployed by the Government of Mauritius but does not review all urban transport policies that may have been relevant to this paper. The discussion examines citizen needs and preferences as general categories yet may have left out important insights if the needs were sub-grouped by industry, technicians, corporations, public officials or others. Finally, the online survey was not created to be compared with the selected policies, although the topic is similar and the citizen needs were relevant with policy proposals. A minor limitation also lies in the homogenous grouping of the online and face-to-face samples which may cause bias if results are considered by location of residence. Further research is necessary to explore the interface between needs and policies in LMICs, particularly regarding gender differences and social equity.

#### 4.6. Policy recommendations with highlights on LMICs

Based on the findings of this study, we propose three general recommendations may be useful to policy makers involved in urban transport planning in LMICs.

1. Plan for citizen-centred approaches by preparing in advance the time, money and human resources to facilitate the integration of citizen needs in policy design and reforms.
2. Analyse, consider and prioritise the gaps that may exist between health, economic and social priorities when investing in large urban and transport planning interventions (Fig. 2).
3. Use citizen needs stratified by demographic indicators to design urban and transport planning interventions aiming for social, health, equity-driven co-benefits.

### 5. Conclusion

To fill research gaps in developing countries, this study used a mixed-method approach to assess the alignment of three urban transport planning measures with self-reported citizen needs in the city of Port Louis. The policies addressed 3 out of 6 needs but did not respond to citizen preferences for active modes of travel. They did not contribute to enhancing health and social co-benefits of transport. Rather the policy measures emphasized an economic agenda focused on transport infrastructure as opposed to reforms in line with public needs that much more strongly highlight the integration of urban transport planning in social life. For instance, the

policy measures did not satisfy the need of citizens reporting for more green spaces, pedestrianizing of strategic areas and regulating entry of private vehicles in town nor did they satisfy mode of transit preference for walking or cycling. The logistic regression models showed an uneven distribution of needs across population groups. Yet, the assessment of policies showed some promising results related to needs expressed more likely to be expressed by populations with low income economic backgrounds. Those involved satisfying needs such as improving sidewalks and freeing space occupied by street vendors. The paper concludes that considering citizen needs provides a unique opportunity to reform urban transport planning policies towards more healthy and equitable cities in the developing world.

### Author contributions

The individual contributions of each authors are as follows: conceptualization, M.T., O.M., and M.J.N.; methodology, M.T., S.M.; software, M.T. S.M.; validation, M.T., O.M., and M.J.N.; formal analysis, M.T.; investigation, M.T.; resources, M.T.; data curation, M.T., S.M.; writing—original draft preparation, M.T.; writing—review and editing, M.T., O.M., and M.J.N.; visualization, M.T., O.M., and M.J.N.; supervision, M.J.N.; project administration, N.A.; funding acquisition, N.A.

### Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### Financial disclosure

The Authors did not receive any specific funding for this work.

### Declaration of competing interest

The authors declare no conflict of interest.

### Acknowledgements

We thank Landscape Mauritius Ltd who granted access to the survey dataset from which we extracted citizen needs. We thank all study participants and stakeholders involved this study. We also acknowledge the input and comments on this draft from Dr. Joyeeta Gupta (University of Amsterdam), Dr. Daniel de Vries (University of Amsterdam) and Dr. David Rojas-Rueda (University of Colorado).

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jth.2020.100944>.

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