

Supplementary material for “The governance conundrum of powered micromobility devices: An in-depth case study from Singapore”

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Supplementary Material A

| | Powered Bicycle | Powered Standing Scooter | Powered Seated Scooter | Powered Self-Balancing Board | Powered Non-Self-Balancing Board | Powered Skates |
|-----------------------------|-----------------|--------------------------|------------------------|------------------------------|----------------------------------|----------------|
| Center column | Y | Y | Y | Possible | N | N |
| Seat | Y | N | Y | N | N | N |
| Operable pedals | Y | N | N | N | N | N |
| Floorboard / foot pegs | Possible | Y | Y | Y | Y | Y |
| Self-balancing ² | N | N | N | Y | N | Possible |

Figure S1. Powered micromobility devices listed by SAE International [1].

Supplementary Material B

Detailed case description

Phase 1: Recognising the importance of PMDs and setting the agenda for active mobility

The initiative towards promoting micromobility in Singapore kickstarted in 2013 when the LTA masterplan discussed the importance of the first-mile and last-mile connectivity [2]. After that, the Sustainable Singapore blueprint (2015) was unveiled on 8th November 2014 when the Transport Ministry in Singapore made ‘car-lite Singapore by 2030’ a major theme for the year and even launched the ‘Walk, Ride, Cycle’ campaign to encourage commuters to take public transport rather than driving cars. Adopting PMDs comprising of electric scooters, hoverboards and unicycles as modes of transport became a major catalyst for this change. An Active Mobility Advisory Panel (AMAP) was set up in March 2015 to identify rules for using footpaths, shared paths and cycling paths by users of active mobility devices.

The AMAP comprises different stakeholder representatives of youngsters, seniors, and users of those devices. The aim was to determine rules to ensure safety while meeting the requirements of mobility device users and pedestrians. Through surveys, focus group discussions, and interviews, the panel suggested the first set of rules for the devices in a report published in March 2016 [3]. The speed limits of 15 km/hr on footpaths and 25 km/hr on shared and cycling paths were recommended. Three criteria for maximum width (700 mm), maximum weight (20 kg) for bicycles and PMDs, and a maximum speed of 25 km/hr for motorised devices were suggested. It was recommended that bicycles and e-bikes can be allowed on roads, but PMDs and PMAs should be allowed only on footpaths, cycling paths and park connector networks. The panel also suggested requirements in devices and a general code of conduct to use PMDs and PMAs. The devices were to be equipped with white light and red light in the front and back respectively, to be turned

on in the dark, or the user must wear a luminous vest or light on the helmet. The code of conduct recommended involved ringing the bell or giving an audible signal when overtaking, ensuring all parts of the active mobility devices are in proper condition and stopping to render assistance in case of an accident. In addition, motorised bicycles that run on roads and are susceptible to be modified had been recommended to be registered. The recommendations also included educating and increasing awareness amongst the public. All recommendations were accepted by the government to be put forward in the parliament for debate.

Till the AMAP published their report in March 2016, there were no clear regulations for PMDs, and there was no clear differentiation between different types of PMDs including bicycles. In September 2016, the accident of a woman who suffered severe brain injury involving a teenager riding an e-scooter raised concerns about the safety of PMDs, especially e-scooters [4]. A Safe Riders Campaign and Safe Cycling Programme for educating cyclists and PMD users about the code of conduct, rules and penalties were also planned to improve awareness efforts. With time, electric scooters or e-scooters became more popular. LTA established an active mobility enforcement officers' team to advise cyclists and PMD users if they exceeded the speed limits or did not follow any code of conduct. There were also active mobility patrol teams comprising of volunteers to spread information about safe riding and rules. Since the government's main motive was to increase the use of public transport, a six month trial was undertaken in November 2016 under which the commuters could carry their PMDs on buses or trains provisional on the size standards [5].

Phase 2: Introduction of Active Mobility Bill (2017) and e-scooter sharing services along with increased surveillance

Singapore follows a parliamentary democracy system with three branches for governance: 1) the legislative branch (the president and parliament), 2) the executive branch, and 3) the judicial branch. Reforms are undertaken through a legislative process whereby a Bill is introduced by Members of Parliament, Cabinet Ministers, or citizens [6]. There are readings and debates on the bill and inquiries by a Select Committee in case it requires special consideration (*ibid.*). The bill is then investigated by the Presidential Council of Minority Rights and presented to the President after which it becomes a law [7].

In Singapore, the Active Mobility Bill was passed in the Parliament in January 2017 and became the Active Mobility Act (2017) on 20th June 2017. This was crucial in safely legitimising the use of PMDs with proper rules and codes of conduct [8]. The Act comprises issues related to the declaration of public paths, sharing of public paths, and sale of PMDs. To enforce rules related to PMDs, the Act authorised an active mobility patrolling scheme with authorised officers, public path wardens, and volunteers [9]. The regulations disallowed power-assisted bicycles on footpaths and banned e-scooters on public roads, with prescribed speed limits of 15 km/hr on footpaths and 25 km/hr only on park connectors and shared paths for e-scooters. As the regulations were being enforced, there were various stumbling blocks with the growing popularity of PMDs. The pathways were likely to get crowded, and there had been an increase in cases of speeding and reckless driving of PMDs [10]. To improve safety measures, recommendations were made to use helmets by users of PMDs, introduce third party liability, and use speeding guns and setting up CCTV cameras in high-risk locations [11]. The government also announced the compulsory registration of e-bikes with LTA and a requirement of a number plate on the bikes. The fine for offences related to PMDs was SGD 100 for a first-time offence irrespective of the road the device is driven on, SGD 200 for a second offence and SGD 500 for the third and subsequent offences [12].

Meanwhile, steps were taken to make the residential area of Ang Mo Kio (AMK) the first walking and cycling town in Singapore. To enable this, infrastructure for cyclists and pedestrians was built for connection to mass rapid transport (MRT) station, swimming pool and AMK hub [13]. In addition, since the number of commuters increased, locker services were made available in a community club in AMK to store PMDs. They were

made available for free for a month, and it was decided to charge them later based on the usage rates and feedback of residents. By June 2017, a local start-up Telepod introduced the first e-scooter sharing in Singapore starting operations in the Suntec city area. The e-scooters with GPS and alarm systems were available on rent for six hours. Soon after this, in the same month, Neuron Mobility (a local start-up company), in association with Ascendas-Singbridge started a six month pilot by providing five e-scooters and twenty bikes at reasonable rental prices across places in Science Park 1 [14]. By the end of June 2017, Telepod (a local start-up company) and Floatility (a German e-scooter networks firm) offered e-scooters that were available via an app in specified zones of the One-North area. This can be highlighted as the introduction of e-scooter sharing services in Singapore. Telepod and a local start-up Neuron Mobility also provided e-scooters for hire in Suntec city and Science Park 1 during June 2017 trials with a tracking system in place [15]. PopScoot (a company based in Singapore) started an e-scooter sharing service in heartlands and downtown areas in August 2017.

While there were developments in the adoption and use of e-bicycles and PMDs, the number of accidents leading to injuries increased. The LTA began registration of e-bicycles in August 2017 with a deadline of 31st January 2018 beyond which fines or jail were to be imposed. The e-bikes were required to undergo an inspection, possess a seal of the LTA and number plate. The figures for accidents involving e-bikes increased from 39 to 54 between 2015-16 [16]. No separate accident statistics for PMDs were reported until the end of 2017. There was also a difference in the regulations for e-bicycles and PMDs. E-bicycles required approval from LTA, while this was not required for PMDs [17]. In January 2018, it was reported in a parliament session that out of the 110 accidents between January and September 2017, 30 accidents involved pedestrians and PMD users on public paths, while the rest were due to illegal riding and crossing on roads.

In the later months of 2017, the cases of speeding, illegal modifications of PMDs, and fire accidents from the battery of e-scooters also increased. To deal with the fire incidents, the Singapore Civil Defence Force (SCDF) communicated warnings on social media (Facebook page). The advisory issued included the following: 1) PMD batteries not to be charged overnight or left unattended, 2) PMD batteries or PMDs not to be placed near combustible materials or escape routes, 3) placing PMDs on hard surfaces for proper diffusion of heat and 4) being cautious about any damages or defects in the battery of e-scooters due to bloating or corrosion. SPRING Singapore and LTA decided to review the testing and certification requirement for PMDs which are not part of the AMA. In an inspection during November-December 2017, SPRING Singapore found that six e-scooter suppliers-- CarbonRevo, Emarco Enterprise, Escoot.sg, Falcon PEV, Minimotors - Maxtech Plus and Skateline SkateSchool were selling unregistered charging adaptors for PMDs and illegally modified PMDs after seizing 175 items from them [18]. SPRING Singapore was the Standards, Productivity and Innovation Board, the standards setting statutory board under the Ministry of Trade and industry in Singapore. It merged with IE Singapore in April 2018 and became Enterprise Singapore.

Phase 3: Recurring policy evaluation and more regulations for active mobility devices

The frequency of accidents and the increasing number of offences involving PMDs became a cause of concern for the LTA. By January 2018, the LTA had more than 50 enforcement officers and equipped them with speed guns to check the speed of micromobility devices. The issue of applying rules to the various types of PMDs also became a matter of contention. Due to the conflation of types of micromobility devices, there was a lack of distinction of rules between PMDs, e-bicycles and PMAs. There was also the realisation of lack of necessary infrastructure for PMDs, with some narrow walkways, broken stretches of paths or blocked by trees, lamp posts etc. and paths that are not well-lit [19]. In most areas, such as Yishun and Ang Mo Kio, the users were abiding by the rules; however, in Geylang PMD users were flouting rules that increased the risk of accidents [20]. Accidents involving PMDs averaged 3 in a week between January-September 2017 [21]. The idea of power-assisted PMDs to be registered and provision of third-party insurance

was introduced when the Transport Minister provided an update on the accidents between PMD users and pedestrians [22]. This led to a slew of regulations imposed on PMDs for safety.

From 15th January 2018, the LTA increased the fines for offences related to the use of PMDs by three times—SGD 300 for a first-time offence on a local road and SGD 500 on a major road; driving on expressways was to be charged in court with a maximum penalty of SGD 2000 and jail for 3 months [23]. To create more awareness about safe riding, LTA started a Safe Riding Programme in schools, community clubs and foreign worker dormitories involving a 90-minute theory and practical lesson and information campaigns comprising of banners on lamp posts to create awareness on safety aspects while riding PMDs were also undertaken [24]. The food delivery riders of companies such as Grab Food, Foodpanda and Deliveroo also formed a key segment of PMD users, and in anticipation of the increase in the frequency of deliveries during the festive season in Chinese New Year, the Workplace Safety and Health Council published a guide on safe riding for food delivery riders outlining provision of storage spaces in PMDs for ease of carrying packages, training on safe riding behaviour for riders [25]. In February 2018, AMAP proposed mandatory registration of e-scooters (not hoverboards and electric unicycles), and the LTA accepted it with the hope to discourage reckless riding, provide more responsibility to the users, and help enforcement officers in tracking down the reckless users [26].

Phase 4: Enforcement of Active Mobility Act, stricter regulations, and introduction of Land Transport (Enforcement Measures) Bill 2018

With the enforcement of AMA on 1st May 2018, the users of PMDs had to adhere to all the regulations, which had become even more stringent with the imposition of the law. The LTA also provided speed guns to enforcement officers to catch reckless users of PMDs [44], and auxiliary police officers from Certis Cisco were employed for the enforcement of rules [28]. The Land Transport Master Plan (LTMP) 2040 was introduced on 25th May 2019 with a threefold aim of active mobility devices played a key role due to the ‘walk-cycle-ride’ modes of transportation that were outlined.

By this time, there was a growing sentiment of PMDs being risky and demanding a ban, with the increase in hit and run and collision cases involving PMDs [29]. In addition to that, the pedestrians were negatively affected by the PMDs. On 15th May 2018, in the parliament, MP Dennis Tan recommended lowering the speed limit for PMDs from 25 km/hr to 15 km/hr along with educating road users on safety. Since the AMA was enforced, 332 PMD users had been caught for different offences, and LTA confiscated approximately 9 in 10 PMDs and e-bikes during May-June 2018 [30,31]. Meanwhile, a fire accident due to the battery of a PMD when two boys were injured and the 16 other cases from January to April 2018 brought to light the existing dangers of bad batteries in PMDs [32]. As the size specifications of PMDs were outlined in the AMA, there were also concerns from the disabled community that used PMAs about the application of strict rules for PMDs on PMAs, since some retailers started marketing PMDs with seats as PMAs [33]. The cyclists were another segment of the stakeholders concerned about applying rules meant for PMDs since mountain bikes have more than 70 cm and are also used on shared paths or park connectors [34].

After the inspection in 2017, in a nationwide sting operation conducted on 18 retailers from 17th July to 2nd August 2018 by LTA, it was found that five retailers were advertising or displaying non-compliant PMDs and five retailers had not displayed LTA’s warning notice on technical criteria for the various PMDs and PABs [35] (Refer to supplementary material C figure C1 for the warning notice). In a review of the rules related to PMDs, the AMAP submitted another set of recommendations to regulate PMDs on 24th August 2018. These focused on preventing accidents and improving safety by lowering the speed limits for PMDs on footpaths to 10 km/hr, mandatory wearing of helmets and practice of “stop and look for traffic” at road crossings by the users of active mobility devices [36]. Since the disambiguation of rules for PMDs and PMAs was a concern, a maximum device speed of 10 km/hr was recommended by the AMAP. Voluntary provision of insurance by

employers for active mobility devices was allowed, and the panel encouraged users to get insurance, but it was not recommended to make it mandatory. All the recommendations were accepted by the Ministry of Transport to be imposed from 1st February 2019 [37].

In September 2018, due to the increasing incidence of accidents, the Land Transport (Enforcement Measures) Bill was passed in the parliament to enforce tougher regulations on active mobility devices [38]. The Bill covered all major concerns that were listed in the proposals to regulate active mobility devices (*ibid*):

1. Mandatory registration of e-scooters: This involved registration of the particulars of the user and specifications of the e-scooter (width, weight, and restrictions on speed) from early 2019. The registration number with an identification mark on the e-scooter was required for identification by enforcement officers and tracing any reckless riders (recreation of markings on e-scooter in supplementary material C Figure C2). Section 20A of AMA set out fines upto SGD 2000 and/or upto three months in jail for non-compliance. In case of a sale of PMD, the registration was transferable to the buyer [39]. LTA fixed the start date for registration of e-scooters (PMDs with handle-bars) from 2nd January 2019 to June 2019 (later extended to 1st July 2020), with a fee-waiver until 31st March 2019 [40].
2. Rebuttal presumption rule for some offences: According to Section 59A of the AMA, rebuttal presumption rule could be applied in case of an accident involving a bicycle, e-bike, PMD or PMAs. This meant that if an owner of an active mobility device cannot prove that he was the rider of the device in the event of an offence, it would be presumed that the owner is responsible unless there is a rebuttal of the presumption by proving otherwise.
3. Regulations for PMAs: The Bill sought to clarify the ambiguity in rules for PMDs and PMAs, and control the problem of users circumventing rules by advertising non-compliant PMDs and able-bodied people using PMAs. A maximum speed limit of 10 km/hr was decided for PMAs and the sale of non-compliant mobility vehicles was prohibited.
4. Fire safety standards for PMDs: The UL2272 standard developed by an independent certification company in the United States was found most suitable for motorised PMDs in Singapore. Hence, only those motorised PMDs that complied with the UL2272 were allowed from January 2021. However, this deadline was changed to 1st July 2020 in a ministerial statement in the parliament on 5th August 2019 [41].
5. Employment of outsourced enforcement officers (OEOs): The appointment of OEOs was made official in the bill to assist LTA's needs for enforcement of rules. These individuals would have to wear uniforms and possess identification cards, be given limited powers, and would be prohibited from using the power to arrest.

Phase 5: Regulations for e-scooter sharing companies and steps taken to ensure the safety of PMDs

By 2018, many e-scooter sharing service providers had started to show interest in operating in Singapore. Before this, the e-scooter sharing companies were allowed to operate only in areas via an agreement with the private townships. On 23rd October 2018, LTA made a statement for interested device-sharing companies about the requirement of a license for operation, and fines for unlicensed operators upto SGD 10,000 and jail up to six months with SGD 500 for every additional day of operation [42]. The license applications were supposed to be invited every year twice a year and the first slot was for January 2019. During this time, 42 shared e-scooters were confiscated after the companies Neuron Mobility, Telepod, and Beam were found to have been operating without license or exemption, despite the repeated reminders and warnings between July-October 2018 [43]. Telepod and Neuron Mobility had been allowed to operate only in specific locations without a license, based on an agreement with the landowners. LTA also clarified that they would allow only small-scale operations (with a limited fleet of PMDs) for PMD sharing operators through an application process for 'sandbox licenses'. Fourteen companies-- Lime, Bird, Beam Mobility, Telepod, Anywheel, Gogreen, Grab Wheel, Helbiz, Moov

mobility, Mover Scoot, Omni Sharing, SG Scoot, Smart World Telecommunications and Mobike applied for the sandbox license to operate a minimum of 200 devices and a maximum of 500 in the application cycle ending 11th February 2019 [44]. However, during the waiting period for approval, LTA confiscated 68 PMDs of Telepod and 144 PMDs of Neuron Mobility [45] that were operating without a license. LTA clarified that the evaluation of applications would consider companies' compliance with the regulatory requirements and their track record, emphasising the seriousness of penalties for unlicensed operators [46]. Neuron Mobility and Telepod were later charged in court for providing PMDs without license or exemption and fined SGD 38,000 and SGD 16,000 respectively in September 2019 [47]. The companies ceased operations in July and August after it was no longer financially viable for them to operate.

To promote the 'car-lite society' vision in Singapore, the Car Parking Standards (CPS) and Range-based Car Parking Standards (RCPS) were revised and PMDs were affected by the parking provisions [48]. The areas of Marina South, Kampong Bugis, Woodlands North, Bayshore, and Jurong Lake District were designated as the new growth areas for car-lite boundaries (*ibid*). Paths planned to be made for a cycling network for ease of travel to MRT stations and neighbourhood places and are supposed to reach 700 kms by 2030, would be operational for e-bikes and PMDs as well [49].

As safety became an important concern in the operation of e-scooters, a Grab scooter trial at the National University of Singapore was suspended for a week in May 2019 because the safe-riding habits were not being followed [50]. To catch reckless riders, LTA also introduced CCTVs at hot spots and a regulation whereby users of MyTransport.SG app could send pictures or videos and report irresponsible riding of PMDs for greater enforcement efforts in June 2019 [51]. By 24th September 2019, 270 reports had been filed by members of the public on reckless riders of PMDs [52]. The discussions about PMDs in the parliament also started focusing on safety, by contemplating on giving town councils the right to ban the use of PMDs at void decks after a call by the residents and members of the parliament. Void decks in Singapore refer to the ground floor of the housing development board (HDB) blocks. These are made as sheltered blocks where people can meet or get together. With 31st June 2019 as the deadline for registration of e-scooters, the retailers started selling them cheaper [53] and LTA received more than 85,000 registrations for e-scooters with 4% registrants between the ages of 16 to 20, 75% registrants between the ages 21 to 50 and 21% registrants were 51 years old and above [54].

By the second half of 2019, the operation of PMDs had become a controversial topic due to safety concerns. There were major announcements made in the ministerial statement in the parliament on 5th August 2019 [41]. First, the deadline for compliance with UL2272 standards for safety from fire accidents was brought forward by six months to 1st July 2020 and early disposal of non-UL2272 compliant devices while working with National Environment Agency was determined. Second, a mandatory inspection of PMDs with UL2272 certification and compliance requirements listed by LTA at pre-decided centres was decided to begin from April 2020 [55]. Third, for path safety, it was decided to extend the cycling path network in Singapore and to spend SGD 50 million on expanding the infrastructure for PMDs (like widening the footpaths and putting warning signs) [56]. Few of the entire lanes in the Ang Mo Kio area were to be made into cycling paths. Fourth, 15 town councils under the People's Action Party decided to ban PMDs at void decks and common places of HDBs from 1st September 2019 with a penalty of SGD 5000 after 31st October 2019. This ban of PMD on void decks did not apply to PMAs. In addition, there was also a decision to undertake a three-month trial of zones where PMD riders will have to dismount and push the devices in those pedestrian-free zones. Fifth, By September 2019, markings on footpaths, including "slow" markings, "enhanced visual cues" for PMDs would be made on a trial basis. Finally, it was decided to employ more members in the LTA enforcement team to 200 by the end of 2019.

Since fire accidents were also a related concern with PMDs, a government task force comprising the Singapore Civil Defence (SCDF), LTA, the Housing Board, and Enterprise Singapore was established in August 2019 to manage the related problems [57]. In

September 2019, LTA introduced an early disposal scheme for e-scooters that were non-compliant with UL-2272 requirements at 180 disposal points by offering an incentive of SGD 100 with 31st March 2020 as the deadline [58].

Phase 6: Increasing safety concerns, ban on e-scooters, and amendments in the Active Mobility Act

LTA delayed the issue of sandbox licenses further to consider more requirements on the 12 applicants to ensure the general public's safety [59]. Despite the attempts to control reckless operation of PMDs, the sudden increase in offences related to active mobility devices from 595 in July 2019 to 761 in August 2019 was concerning [60]. The death of a 65-year-old cyclist due to a collision with a non-compliant PMD (exceeding the weight and width restrictions) on 21st September 2019 further attracted attention to the risks in the operation of PMDs in Singapore. In a review of regulations for active mobility devices, the AMAP submitted their recommendations on 27th September 2019. The recommendations were made for mandatory third-party liability by businesses for their employees, a minimum age requirement of 16 years to ride e-scooters, a mandatory theory test for e-scooters users before riding the devices, and a ban on using mobile phones while riding a device (except when it is used hand-free) [61]. In addition, a code of conduct for pedestrians was also proposed for safe sharing of public paths with active mobility device users—to keep left, to be on the footpaths and be alert.

The possibility of a ban began to brew after calls from citizen groups and victims of accidents due to PMDs to ban them from footpaths through online petitions [62], and a statement by a Senior Minister of State for Transport on the need to improve the behaviour of PMD users on 7th October 2019 to avoid a ban. This triggered a comprehensive review from the government. By this time, the government clamped down on a PMD retailer by imposing a penalty of SGD 50,000 after iPassion Group Pvt. Ltd. was found to be selling unregistered PMD charging adaptors without a SAFETY mark. Under the Consumer Protection (Safety Requirements) Regulations (CPSR), there are 33 controlled goods (household items) that need to be registered with Enterprise Singapore after meeting the safety standards and be affixed with SAFETY mark, to be sold in Singapore [63]. Battery chargers and adaptors are part of those controlled goods. In response to the increasing accidents involving PMDs, a group of 27 retailers pledged to the following norms: 1) to restrict the sale of PMDs to those under 16 unless accompanied by an adult, 2) abstain from illegal modifications of PMDs, 3) provide service to only registered PMDs, 4) discourage unregistered businesses of PMDs and 5) promoting awareness through social media and other resources while working with authorities in accordance with the laws [64]. These retailers were: Kernel Scooter, CubeRpedia, ComponentSingapore, Gadget4Fun, Scoot Ezy, ElectroWolf, 12Cycle, Dcycle, Mobot, ScooterKidz, Falcon PEV, Scootway, PT Scoot, WarehouseSG, Trust Wheels, Scooter Hub, Minimotor, Synergy Scooters, Fabulous Scoot, Scooby, Minimotor Studio, EscooterDivision, iPassion Group, Team Aeroworks, 25KMH, and Last Mile Solutions.

In October 2019, three condominiums had banned the entry of PMDs used by food delivery riders [65]. After the comprehensive review by the government, LTA finally banned e-scooters from all footpaths (except cycling paths and park connector networks) from 5th November 2019 [66]. An advisory period was slated till 31st December 2019, after which heavy penalties of SGD 2000 and/or 3 months of imprisonment was decided. In addition, LTA rejected all existing license applications of e-scooter sharing companies and prohibited any applications in the future. The deadline for disposal of non-UL2272 certified e-scooters was extended to 31st December 2019. The ban had heavily hit the food delivery riders who relied on PMDs, and retailers of e-scooters in Singapore. The government introduced a 'transition assistance package' by providing an SGD 7 million grant, called the e-scooter Trade-in grant (eTG) for the replacement of e-scooters with SGD 1000 to buy an e-bike or SGD 600 to purchase a bicycle for approximately 7000 riders [67]. This grant was funded equally by the government and the three food delivery companies—GrabFood, Foodpanda and Deliveroo. Since the livelihoods of the food delivery riders

were at stake, another option to switch jobs through the help of the Employment and Employability Institute (e2i) and Workforce Singapore (WSG) was provided (*ibid.*). However, retailers were left with unsold stocks.

In February 2020, a bill for amending the Active Mobility Act was introduced, focusing on PMDs and the use of public paths. This bill introduced more stringent regulations which comprised of the following: ban on all types of PMDs on footpaths, requirement of a competency test certificate for riders of PMDs, the under-aged riding of motorised PMDs, to illegalise the use of mobile phones when driving on public paths, to make third-party insurance mandatory and increase the penalties for offences related to using active mobility devices. The Shared Mobility Enterprises (Control and Licensing) Bill was also passed on 4th February 2020. The major implication was for licensing regulations for business operators offering docked motorised PMDs and PABs for hire in public places from April 2021 [68]. This prescribed two types of licenses for device-sharing business operators – ‘regular’ licenses for dockless motorised and non-motrised devices, and ‘class’ licenses for docked motorised device sharing firms [69].




In May 2020, the small motorised vehicles (safety) bill and another amendment to the AMA was introduced in the parliament. The main motivation was to require all importers to obtain approval to import PMDs from LTA, restrict imports of illegally modified PMDs, and to allow LTA to quickly forfeit any non-compliant micromobility device [70]. The path-connected open spaces were also included as public paths to clarify the connotation of public paths. A circuit breaker was imposed from 7th April 2020 to 1st June 2020 in Singapore for people to stay at home during the COVID-19 pandemic to reduce transmission of the virus. The code of conduct for pedestrians was enforced from August 2020 [71] and the regulation for third-party liability insurance by businesses for employees using PMDs for atleast SGD 20,000 was enforced in December 2020 [72].

The AMAP submitted another set of recommendations in December 2020 highlighting the importance of the third-party liability insurance for commercial users with the suggestion of monitoring the situation before making it mandatory for non-commercial users [73]. In an announcement, the Minister of State for Transport reported that accidents involving motorised PMDs showed a significant decline of 79 per cent to 30 between 2019 and 2021, after the ban and there would be an expansion of paths for use of active mobility devices [74].

Land Transport Authority

WARNING NOTICE

Technical Specifications for Bicycle and Personal Mobility Device (PMD) Used on Public Paths

| | | |
|---|--|--|
| <p>Maximum Unladen Weight</p> <p>20 kg</p>  | <p>Maximum Device Width</p> <p>70 cm</p>  | <p>Maximum Device Speed (only for motorised devices)</p> <p>25 km/h</p>  |
|---|--|--|


Technical Specifications for Power-Assisted Bicycle (PAB) Used on Public Paths and on Roads


Must be affixed with LTA seal of approval

20kg Maximum weight of PAB must not exceed 20kg

Maximum power output rating of PAB's motor must not exceed 250W

Must have EN 15194 marking that shows the PAB complies with the European Standard





PAB must not have start-up assistance feature or throttle

Construction of PAB must be similar to that of a conventional bicycle


Cyclist must pedal to start the motor

Motor power output of PAB must be progressively reduced and finally cut off as the bicycle reaches 25km/h, or sooner, if the cyclist stops pedalling


25 km/h

PENALTY for riding non-compliant bicycle, PMD or PAB on public path
FINE up to \$5,000, or JAIL up to 3 months, or BOTH


Where Devices Are Allowed To Be Used




Pedestrian-only Path




Footpaths





Cycling / Shared paths




Roads

 **Bicycle**

 **Personal Mobility Device**
(eg. kick scooter, electric scooter, hoverboard, unicycle)

 **Personal Mobility Aid**
(eg. motorised wheelchair, non-motorised wheelchair, mobility scooter)

 **LTA Approved and Registered Power-Assisted Bicycle**

*Riding of personal mobility devices, power-assisted bicycles or bicycles may be banned on certain footpaths or shared paths even if compliant

PENALTY for riding bicycle, PMD or PAB on pedestrian-only path

FINE up to \$1,000, or JAIL up to 3 months, or BOTH

PENALTY for riding PAB on footpath

FINE up to \$1,000, or JAIL up to 3 months, or BOTH

PENALTY for riding PMD on road

FINE up to \$2,000, or JAIL up to 3 months, or BOTH

Repeat offenders may face higher court fines / jail terms

Figure S2. Warning notice for bicycles and PMDs by LTA.

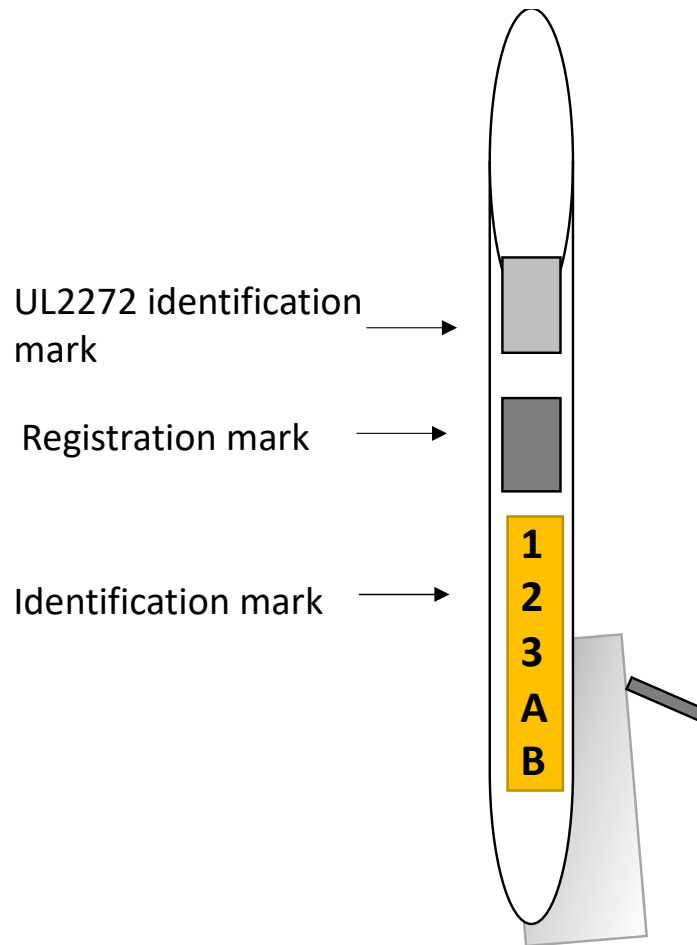


Figure S3. UL2272 identification mark, registration mark, and identification mark recreated on the handlebar of an e-scooter.

Source: Authors, Adapted from <https://mobot.sg/blog/5-things-you-may-have-missed-on-lta-electric-scooter-e-scooter-registration/>

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