

# **MOTORIZED TWO-WHEELERS: CONTRASTING ASPECTS, RECURRING PROBLEMS AND SOLUTIONS FOR MORE COMPREHENSIVE URBAN TRANSPORTATION POLICIES**

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## **ABSTRACT**

Powered Two-Wheelers – PTWs are very popular modes both in developed and industrialized Countries, nevertheless, despite their considerable use, they tend to be ignored in transportation organization and planning; as a consequence, poor safety level, environmental concerns, no proper knowledge of riders' behavior and motivation, along with the lack of comprehensive policies in which two-wheelers are integrated within a balanced mobility system, are recurring problems due to the underestimation of their role in the city traffic. Case studies of London, Hanoi, Rome and Bogotà, which have extensive use of motorcycle/mopeds, are presented, stressing commonalities and peculiarities. The need of a proper assessment of the role of two-wheelers in the urban mobility management is the core of the lesson learned from all the case studies. To overcome such a barrier three main lines of actions are recommended: revision of the decision process, both at institutional and at regulatory levels; technical progress to develop more efficient safety measures and cultural challenge involving decision makers, road users, planners and designers.

*Keywords: two-wheelers, mobility planning, safety, environment, London, Hanoi, Rome, Bogotà*

## **INTRODUCTION**

As a mode of urban transportation, motorized two-wheeler vehicles (motorcycles, mopeds, scooters), also known as Powered Two-Wheelers – PTWs, encompass a great variety of vehicles and they are used for a wide range of purposes. This mode plays different roles: from marginal for a few travellers in some industrialized Countries, to “unavoidable” in some others, particularly in moderate climates, to dominant in many developing Countries.

Typical of this mode is to be addressed as a safety issue, but PTWs are rarely analyzed with respect to their traffic impacts, capacity implications or special traffic engineering needs, such as separate lanes. Moreover, motorcycles and mopeds present serious system problems, such as congestion, undisciplined behavior of their users, negative environmental impacts, unfavorable consequences on city’s livability.

However, despite its considerable use, this mode tends to be ignored in transportation organization and planning; indeed policies with respect to encouragement/discouragement of the use of two-wheelers and whether special facilities should be provided are typically non-existent at municipal, provincial or government level.

As a consequence two-wheelers, on the one hand, are experienced as a cumbersome (but necessary) presence in the traffic patterns of many urban areas and, on the other, as a looming or blurring entity when dealing with mobility governance.

Nevertheless, even though “contrasts” and “uncertainty” seem to be the most recurring keywords accompanying PTWs, the paper describes how efforts to cope with its extensive use have been made. In particular, thanks to some case studies in Asia, South America and Europe (further described) where either measures have been implemented or even dedicated policies have been enforced, the paper aims at highlighting that it is possible to have two-wheelers playing a proper role, coherent with the citizens needs and the community requirements for safer and more livable environments.

## **A COMPLEX MATTER**

Problems with the motorcycle/moped mode start just from its definition and classification; indeed it seems not even clear where to draw the lines of what constitutes a “motorcycle”, since, generally speaking, it can range from a very small moped at 50cc to a huge touring machine in the 1500cc range.

In Europe, under the name of PTWs go both small capacity one-track vehicles with less than 50cc (i.e. mopeds) and high capacity ones with more than 50 cc (i.e. motorcycles), more or less consistent with the European Union definitions of PTWs which, according to the Council Directive 92/61 EC, was as follows:

- Class A: Small vehicles not exceeding 50 cc and 45 km/h
- Class B: Powered Two-Wheelers -125 cc /11 kW
- Class C: Powered Two-Wheelers - 25 kW / 0.16 kW/kg Power to Weight Ratio
- Class D: Other powered two-wheelers than class B and C (Noordzij et al. 2001).

But such capacity or power-oriented classes, even though partly coherent with the majority of PTWs circulating in Europe, is very far from running the whole gamut of motorized two-

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wheelers, being for example three wheeler vehicles, motorized rickshaws, bicycles with electric motor and micro-cars not included.

What seems to be just a matter of wording is instead a problem of proper knowledge of the phenomenon, as the European Conference of the Ministers of Transport – CEMT stressed since 1999; indeed, the CEMT *Resolution no. 99/5 on vulnerable users: mopeds riders and motorcyclists* (CEMT/CM 99 17/Final) recommends “to introduce a more homogeneous classification of the vehicles concerned” in order to “improve data collection relating to the number of vehicles and types of accidents concerned”.

Names and data harmonization is a first effort to put into some order the diversity of vehicles and users characteristics, types of ways they use, purposes of use, etc. which is extremely vast and even, in some cases, contrasting (Figure 1).

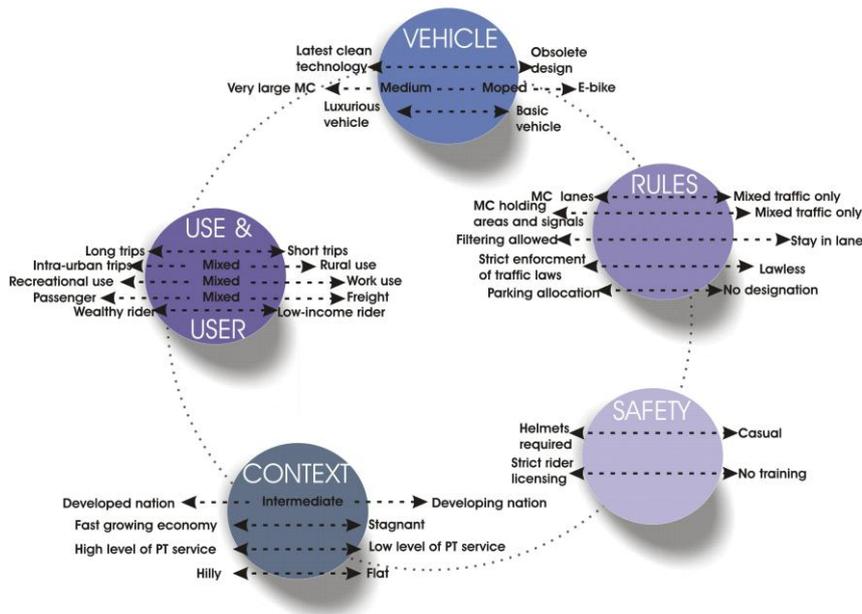


Figure 1 - Categorization of motorcycles aspects and the wide range they span

Indeed, some features of this mode can be rather divergent: from types of safety measures (special training for novice riders vs. no training at all) even up to the image it may convey (glamorous, basic, cheap-but-smart, cheesy etc.); moreover, what seems to be a common cliché in a given area is not so ordinary elsewhere: a very popular mode for hanging around among European youngsters turns out to be a necessary mode to commute in many developing Countries.

However, recurring problems cover at least four main areas:

- the safety issue
- the environmental concern
- no proper knowledge of riders behavior and motivation
- the lack of comprehensive policies, in which two-wheelers are integrated within a balanced mobility system.

So far, poor attention has been paid to the four areas as a whole: safety is seen as the real top priority both by decision-makers and citizens, because of the high toll each country pays in terms of fatalities; this can partly explain why most of the best practices hitherto

implemented concern mainly the enforcement of regulatory measures to raise the safety levels of riders, whereas actions to improve sustainability, not to mention dedicated policies, still lag behind or affect PTWs indirectly. The selection of case studies, further described, and divided per problem area will help understanding such lights-and-shadows picture.

## **The safety issue**

The focus on road safety is usually on data concerning car or non motorized modes accidents, whereas, in general, trends on motorized two-wheelers accidents are rarely analysed and appraised at political level; on the contrary, the public awareness of the risks related to them is very high.

A reason of such a poor attention to data relies on the underestimation of the problem by decision-makers, as proved by the lack of comprehensive sets of mandatory safety measures; indeed, the most common safety devices are helmets, compulsory in many developed Countries, but when it comes to other safety measures as dedicated licensing (with restrictions per ages, level of training, special ban for novices, etc.), riders protection (riding without pillion passengers, zero BAC – Blood Alcohol Concentration for novices, daytime use of headlights for motorcyclists, special clothing, etc.), vehicles improvements (namely in terms of enhanced braking systems and anti-tampering measures especially for small-capacity two-wheelers) and infrastructures adaptation to the riding requirements (above all the avoidance of unevenness of roads and roadsides along with the avoidance of marking foils, which in wet conditions can cause a strong reduction of adhesion) the number of enforcing countries is rather small and the level of enforcement is quite poor (Noordzij et al. 2001). It is also worth stressing the general lack of communication towards the riders, since they have neither a long-time tradition of public involvement on mobility matters nor influential pressure groups to launch this process.

No wonder then if some data are rarely analyzed as, for instance, the riders fatality rates from which some outcomes are worth to be stressed. According to the data provided by the World Health Organization - WHO (2009), the ten Countries with the highest fatality rates ( $[\text{number of PTWs dead riders}/\text{number of inhabitants}] \times 1000$ ) are reported in Table 1 and the Countries with the highest number of PTWs fatalities (number of PTWs dead riders) are reported in Table 2. The figures stress that poor safety levels for riders are typical of both developing and developed Countries, and for the latter especially of two Countries (the United Kingdom and Sweden in Table 1) in which safety is a top priority in the local political agendas since long time. Indeed, such high-income nations, with very high motorization rates (over 500 motor vehicles/ 1,000 inh), in spite of very advanced safety programs (Sweden launched in 1997 the well-known Vision Zero initiative and the UK started in 2005 the Government's Motorcycling Strategy) and total compliance with some basic safety requirements (in both cases the helmet wearing rate is over 90%) are unexpectedly ranked ahead of other low-income, less safety-oriented Countries.

In this case, it seems that the enforcement of very advanced and strict safety measures for other traffic players, as drivers, pedestrians and cyclists could cast some shadows on two-wheelers. A good evidence is what has been defined as the "less recommended story from Sweden": after years of "mopeds decadence", due to a loss of attractiveness of the traditional

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type of moped with a maximum speed of 30 km/h among young people (to which corresponded a decrease of the related safety problems), the introduction of a new kind of two-wheeler vehicle with legal top speed of 45 km/h has revamped the attention to the mode also because no driving licence was required. As a consequence, there is now an increasing number of mopeds riders being killed in Sweden, taking the safety levels back to the 1980's figures (Joint OECD / ECMT Transport Research Centre 2006).

The same "jaunty" attitude toward the mode can be found in the USA (ranked fifth in Table 2) even though because of different reasons as the lack of a national law requiring the helmet use (which is compulsory in just 20 States) or the very recent general enlarged interests for PTWs, considered now "discretionary income goods" and more accepted as a mode of transport (Rogers 2008), with a consequent increase in the number of riders and hence of population exposed to safety risks.

Table 1 - Countries with the highest PTWs fatalities rates, year 2008 (WHO 2009)

	a) Population	b) Reported traffic deaths	c) Reported dead drivers/passengers of motorized 2- or 3-wheelers	d) Dead drivers/passengers of motorized 2- or 3-wheelers	e) PTWs Fatality Rate	f) PTWs Fatality Rate > than Cars Fatality Rate	g) PTW as dominant mode	h) Compulsory helmet and wearing rate
Country	(units)	(units)	(units)	(% of b)	([c/b] *1000)	(Yes/No)	(Yes/No; % of the total registered fleet)	(Yes/No; % riders wearing helmets)
Thailand	63,883,662	12,492	8,707	69.7	1.29	Yes	Yes, 70	Yes, 27
Cook Island	13,325	6	4	60	0.27	Yes	n.a	n.a
Tunisia	10,327,285	1,497	216	14.4	0.16	No	No, 1	n.a
United Kingdom	60,768,946	3,298	627	19	0.14	No	No, 4	Yes, 98
Malaysia	26,571,879	6,282	3,644	58	0.14	No	Yes, 47	Yes, 90 drivers, 70 passengers
Sri Lanka	19,299,190	2,334	1,522	65.2	0.08	No	Yes, 63	n.a
Cambodia	14,443,679	1,668	1,048	62.8	0.07	No	Yes, 84	Yes, 21
Sweden	9,118,955	471	75	16	0.07	No	No, 8	Yes, 95
Suriname	457,964	90	28	31.1	0.06	No	No, 27	Yes, 90
Turkey	74,876,695	6,022	482	8	0.05	No	No, 15	n.a

For what concerns the developing Countries listed in Tables 1 and 2, most of them are in Asia, which can be assumed as the most crucial area for PTWs, not only because 77% of the world PTWs fleet is located there (Rogers 2008), but also because of the coexistence of contrasting factors; Thailand, a middle-income Country, has one of the highest motorization rate (over 300 motor vehicles/ 1,000 inh.) whereas Cambodia, a low-income nation, has one of the lowest (less than 50 motor vehicles/ 1,000 inh.) but in both cases can be found some of the highest percentages of motorcycles among the Asian Countries, comparable to the registered fleets of PTWs respectively of Japan and the Republic of Korea; in spite of the high local fatality rates, in Thailand, Malaysia, Cambodia and Sri Lanka national road safety strategies are enforced (WHO 2009) as in most of the developed countries.

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Moreover, a particular issue arises: many of the Countries listed in Tables 1 and 2 are among the strongest key players in the worldwide production of motorcycles (China, India, Indonesia, Brazil, Thailand, Vietnam and Malaysia) with increasing growth rates in the 1996-2006 period (Rogers 2008); such a market relevance, which entails high economic and technological performances, does not seem to have any likeness in the provision of resources and supports to neither the local decision-makers nor the end-users for what concerns the development of dedicated safety programs.

High PTWs ownership rates, lack of enforcement of regulations and controls can be important reasons but not sufficient, hence, to explain low safety levels as those typical of the developing Countries listed in Tables 1 and 2, and no “chasms” seem to be detectable with the developed Countries, above mentioned, either.

Table 2 - Countries with the highest number of PTWs fatalities, year 2008 (WHO 2009)

Country	a) Population (units)	b) Reported traffic deaths (units)	c) Reported dead drivers/passengers of motorized 2- or 3-wheelers (units)	d) Dead drivers/passengers of motorized 2- or 3-wheelers (% of b)	e) PTWs Fatality Rate ([c/b] *1000)	f) PTWs Fatality Rate > than Cars Fatality Rate (Yes/No)	g) PTW as dominant mode (Yes/No; % of the total registered fleet)	h) Compulsory helmet and wearing rate (Yes/No; % riders wearing helmets)
India	1,169,015,509	105,725	28,969	27.4	0.02	Yes	Yes, 71	Yes, n.a.
China	1,336,317,116	96,611	27,148	28.1	0.02	Yes	n.a.	Yes, 16
Indonesia	231,626,978	16,548	10,094	61	0.04	Yes	Yes, 73	Yes, 93
Thailand	63,883,662	12,492	8,707	69.7	1.29	Yes	Yes, 70	27
Brazil	191,790,929	35,155	7,031	20.0	0.03	Yes	No, 22	Yes, 88 drivers, 11 passengers
USA	305,826,246	46,642	5,271	11.3	0.02	No	No	Not in all states, 58
Malaysia	26,571,879	6,282	3,644	58.0	0.13	No	Yes, 47	Yes 90 drivers, 70 passengers
Iran	71,208,384	22,918	2,613	11.4	0.04	No	No, 37	Yes, 15
Colombia	46,155,958	5,409	1,953	36.1	0.04	Yes	Yes, 39	Yes, 97
Sri Lanka	19,299,190	2,334	1,522	65.2	0.08	No	Yes, 63	n.a.

So reasons must be searched elsewhere. It is worth noticing that “Road accidents disproportionately affect the poor, making road safety an economic development imperative. Most of the victims of road accidents aren’t even in a motor vehicle. Pedestrians, cyclists and motorcycle riders are the most vulnerable road users and account for the majority of traffic deaths in low and middle income countries.... A shortage of safe, affordable travel options makes things even worse for the poor” (World Bank 2009).

Therefore, poverty may be one more reason which affects the decrease of the safety levels for riders in developing Countries, to be set against the slackness of decision-makers from

developed Countries who underestimate the problem, since two-wheelers often are the non-dominant modes in the local traffic patterns and communities of riders are not strong enough or as involved as other vulnerable road users groups usually are. Lessons from Sweden and the USA are rather conclusive, under this point of view.

*Improving safety directly from the roads: the London case study*

It can be argued that presenting a best practice case from a Country with one of the highest PTWs fatality rates (see Table 1) may seem inappropriate; on the contrary, the London case study represents a good example of what could be defined as “taking the bull by the horns”, i.e. starting to reverse a negative trend of fatalities by the implementation of specific safety measures, whose positive outcomes could provide directions towards major dedicated policies. London needs no presentation, it is the most populated city in Europe, about 7.5 million inhabitants in 2007 with about 3 million motor vehicles, the majority of them private cars (2,497,000 units) vs. a modest fleet of 116,000 mopeds and motorcycles (e-SUM 2009), with a consequent minor role of the latter in the local modal split (as in Figure 2).

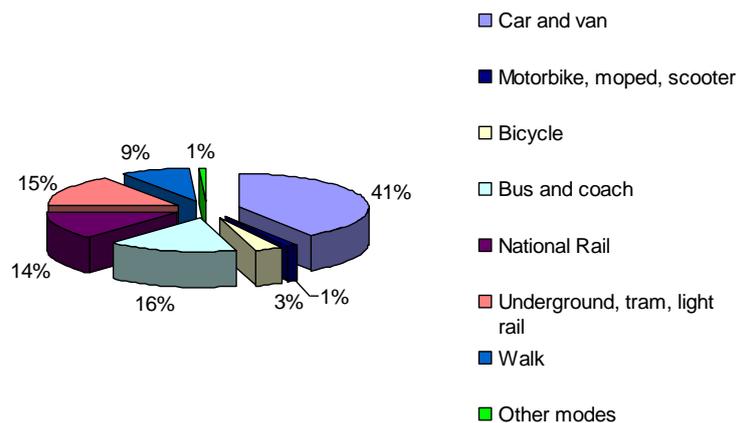


Figure 2 - Main mode of travel to work, Fall 2005 in % in the London Area (Urban Age 2008a).

If compared to the number of PTWs fatalities at national level during the 2000 – 2005 period (Figure 3 shows a decrease of around 5 %, passing from 612 to 584 units), the local trend seems to be even more positive, being recorded in the same period a 20% decrease (from 55 to 44 units) and a further reduction in the following two years, respectively 43 units in 2006 and 41 in 2007 (e-SUM 2009). Such latest results can be seen also as a first outcome from the launch, in 2005, of the aforementioned Government’s Motorcycling Strategy, meant not only to solve safety problems but also to reconsider two-wheelers as a “legitimate and increasingly popular mode of transport” and therefore worth to be included in the traffic management (DfT 2005). The Strategy is a comprehensive tool, exploring all the avenues: from the involvement of a dedicated Advisory Group on Motorcycling, enlarged to the riders community, to the provision of directions and recommendations to solve environmental and traffic problems, to the development of less debated, but not minor, issues at political level, as safety improvements on vehicles and rider equipments, crimes, taxation and human factor.

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Among the solutions recommended to improve the current traffic management there is the proposal to allow riders to use bus lanes, even though the regulatory “Local Transport Notes 1/97: Keeping buses moving” advises against it, but recognizes the right to local traffic authorities to decide differently, where appropriate. A previous positive experience along a bus lane (the M4) was the reason behind such Strategy’s recommendation. As a consequence, the Transport for London Authority decided to start an 18-month trial allowing two-wheelers to travel in most bus lanes, along the so-called red routes, i.e. major arterial roads in London which constitute the urban network of priority routes.

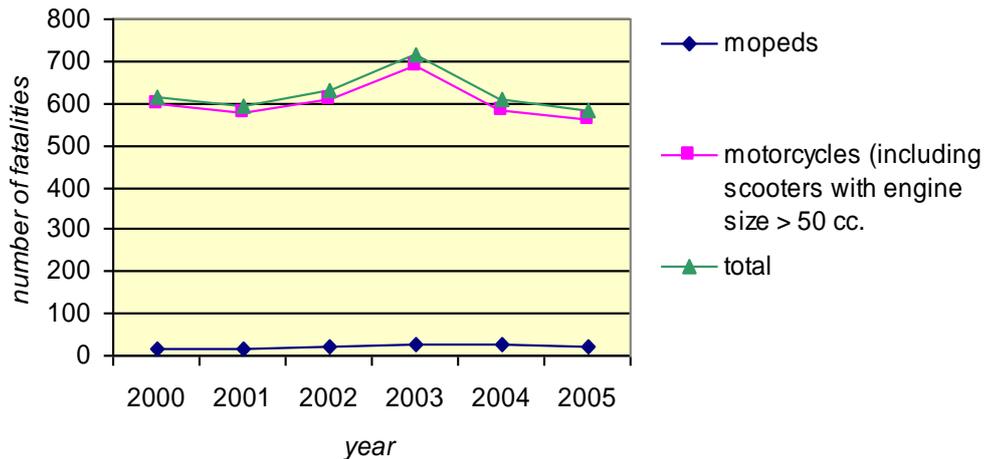


Figure 3 - Number of fatalities in the UK, 2000-2005 (CARE Database 2007)

The measure was launched on January 5, 2009 and after six months of implementation evidence gathered so far seems rather remarkable. The difference in the number of accidents involving two-wheelers “before” and “after” has been assessed as not statistically relevant (namely because of the short-time period of monitoring), for casualties involving PTWs riders or passengers passed from 93 (period: January 5, 2008 – April 30, 2008) to 118 (period: January 5, 2009 – April 30, 2009), those between motorcycles and pedestrians did not vary (16 “before” and “after”) and the total amount of collisions involving all modes passed from 369 to 374 events. On the contrary, results coming from a survey, based on 2,012 telephone interviews plus 209 extra interviews with riders only, stress how the safety perception as a result of the trial markedly changed: 72% of the two-wheelers users stated they felt “much/slightly safer”, 19 % “no different” and just 3% said “much/slightly less safe”; “increased safety/reduction of accidents” was the most common reason for supporting the measure (40%) along with its capability to “keep motorcycles away from traffic/out of traffic lanes” and “help reducing congestion/improve traffic flow” (both 19%). Supporters of the measure outnumbered the opponents three to one, however the latter stated that motorcycles on bus lanes were unsafe (33%), this was the reason to inconsiderate riding (18%) and increased risks for the other road users and pedestrians (15). When asked what would they do if the trail were to become permanent, the majority of PTW users stated that “they would ride more” and only 2% stated that they would ride less (TfL 2009).

Even though no consolidated results are available yet, the lesson learned from this measure confirms that it is very difficult to modify either infrastructures or the current regulatory tools

just to meet the riders requirements (which in past times led to “niche” solutions as the Motorcycle Only Lanes, built in Malaysia since the 1970’s, whose transferability is still strongly debated); the London trial indicates, on the contrary, how decision-makers should address the problems in a comprehensive way, thanks to a bottom-up approach in which public awareness and acceptance, technical solutions and the possibility to amend regulations equally contribute to process of revising safety policies so far enforced.

## **The environmental concern**

The binomial “PTWs – Environment” is a kind of small “chest of drawers” of which only one drawer, the air pollution one, has been opened, whereas some others, and among them noise, still remain shut.

Many factors contributed to open the air pollution drawer. Indeed, just in 1990s, the awareness that, per kilometre, the average two-wheeler can pollute more than the average gas-fuelled car started to become stronger among decision-makers.

Air quality levels were rather poor in many urban areas of both industrialized and developing Countries but, notwithstanding such a new consciousness, initially the contribution of PTWs was still not properly taken into account and consequences became severe: for instance in Milan, in 2001, PTWs were still the second contributor, after private cars, to the emissions of CO (13%), NMVOC (22%) and CH<sub>4</sub> (23%), according to data monitored by Milan Municipality (2001). Needless to say, PTWs were (and still are) the second mode per number of registered vehicles in the city. However, such a situation does not differ a lot from what takes place in Asia (Table 3).

Table 3 - Motorcycles contribute to air pollution in selected Asian Cities (Kamakate 2008)

City	a) PM <sub>10</sub>	b) HC	c) CO	d) NO <sub>x</sub>	e) CO <sub>2</sub>
	(%)				
Bangkok, Thailand (1997)	14	70	32	<1	n.a
Delhi, India (2004)	53	79	n.a	n.a	n.a
Dhaka, Bangladesh (2000)	42	60	26	4	n.a.
Ho-Chi Minh, Vietnam (2000)	n.a.	90	70	12	40

Evidence of the underestimation of the problem can be gathered by a very common measure, i.e. when improving air quality in a given city means deterring the most polluting vehicles from driving in the area: examples of access restriction enforcement, to fight congestion but with positive outcomes in terms of environmental benefits, abounded in the last decade. However, in areas where PTWs are not the dominant mode, they have been usually exempted from restrictions, since usually it is assumed that their contribution to the overall emission package would be minimum (this is the case for instance of London, where motorbikes and mopeds are neither affected by the Congestion Charge nor by the LEZ – Low Emission Zones schemes); on the contrary, in areas where PTWs role is as relevant as that of cars, local administrators tend to enforce mild restrictions (for instance, in Rome, local administrators enforced a ban for Euro 0 compliant PTWs to enter the central areas but, as further described, no other actions are enforced for the remaining parts of motorcycles and mopeds, which are the majority in the local fleet).

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Moreover, there is a general underestimation of the importance of driving and maintenance: indeed, on the one hand, poor maintenance, typical of vehicles in both developed and developing Countries and particularly dangerous when concerning second-hand vehicles, aggravates the problem, making engines polluting disproportionately to their size; on the other, the poor attention paid to how such vehicles are ridden casts a shadow on the importance of sensible riding to save fuel and pollute less.

Some actions implemented to solve congestion problems, which theoretically could affect positively the environment, seem not to be always appropriate, either. For instance, charging drivers, to have a demand shift from cars to other modes, could just turn into an encouragement of the motorcycle use, in the very common case riders are exempted from any charge (Dft 2005). Even encouraging “green modes” and namely electric vehicles, could have some “contraindications” because of the problem of the lead battery disposal, as stressed by Cherry (2005) for the China situation.

Along with the underestimation of the effects of PTWs on the environment, there is the problem of the vehicle performance. Indeed, for a very long time, motorcycles were not even comparable to cars in terms of environmental performance, being the latter much more ahead, especially for what concerns improvements on the emissions of NOx, due partly to more and more stringent emission standards for cars enforced by the European Commission - EC. But the latest EC Directive on PTWs, the so-called 2002/51/EC, enforced emissions standards which should progressively fill the gap with cars environmental performance, namely in terms of NOx emissions. However, Directive 2002/51/EC is mandatory only in the European Union Countries, and the enforced emission standards do not automatically apply to other Countries (Figure 4), which means that, with few exceptions (as for instance Japan), such “greening” process will be rather slow.

Anyway, thanks to the EC standards, positive achievements have been reached: it is now acknowledged that for what concerns CO<sub>2</sub> emissions motorcycles can be compared to cars, and especially “the smaller machines (e.g. engine capacity less than 400 cm<sup>3</sup>) that dominate the urban/commuter sector, tend to have CO<sub>2</sub> emissions per kilometre travelled of less than half of those of the average car due to their far greater fuel economy” (Dft 2005).

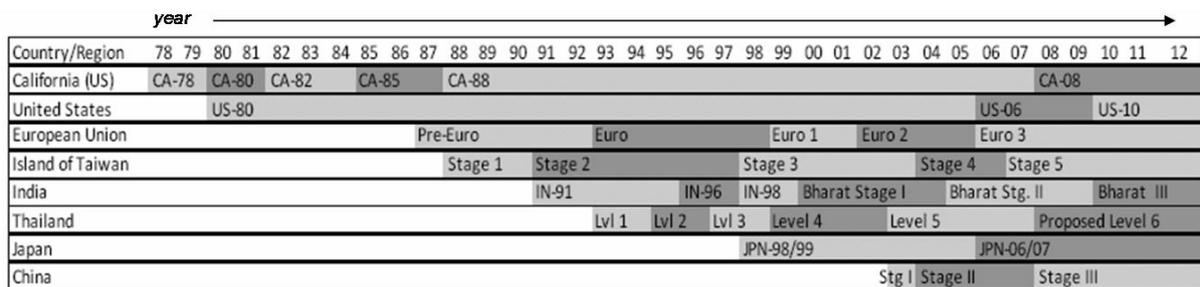


Figure 4 - Motorcycle emission standards timeline (Kamakate 2008)

Unfortunately, noise problems cannot be dealt with the same level of details. Even though some Countries have regulations and/or standards to control noise from motor vehicles (UK, Germany, Switzerland, ecc.) effective actions to abate nuisance from PTWs are still to be implemented. Reasons rely on two facets of the problem: on the one hand, when monitoring

noise in urban environments, it is very difficult to isolate the contribution from mopeds and motorcycles from the general “white noise”; moreover other modes are considered more dangerous, namely poorly maintained cars and buses as they stop and accelerate. On the other hand, not only lack or insufficient maintenance of the PTWs themselves can cause nuisance, but above all modified exhaust systems or even illegal silencers, purportedly installed to create more noise. It is clear that more than regulations to prevent the problem (for instance, anti-tampering devices have been recommended since long time, but young people can't help installing them on mopeds to go faster), a change of mind among the end-users is needed, which can be accomplished only through dedicated, long-time campaigns. More environmental issues remain closed in the chest of drawers, and among them how PTWs can affect land use (or vice versa), seems to be a priority many urban areas will have to tackle very soon, and namely where high PTWs motorization rates must cope with built environments with premium values and scarcity of space. Indeed how motorization can change land use patterns, due to an augmented tolerance towards distance especially for commuting purposes and how mobility management must go in hand with land use planning are well-known and deeply studied issues; but what happens in central areas, with mixed land use and high density patterns still calls for a translation of what theoretically achieved into a set of effective measures. So far, the belief that motorcycles/mopeds are space efficient has led many decision-makers to consider the problem for not sensitive areas only under the parking availability point of view, being aware that roads are usually not designed to accommodate PTWs but cars. Indeed, the space required for a car can host about five mopeds and replacing cars with motorcycles parking spaces could be seen as a smart solution to increase the overall on-street parking capacity and meet riders' parking needs. But in central, densely populated historical areas, with cultural heritage preservation problems, where “mature” land use and traffic policies should be enforced also in light of the lack of available space for cars, the supposed space-efficiency of PTWs prompts decision makers often to set no restrictions for this mode with detriment to the built environment, due to the above mentioned emission problems.

What is a myth to debunk, i.e. “in modern societies, the link between transportation and land use is too weak to matter” (Cervero 1998), on the contrary seems rather true when it comes to the link between two-wheelers and premium value central areas.

### *Healing from air pollution: the Hanoi case study*

From what described above, it is clear that the environmental concern calls for very different approaches, options and solutions, unlike safety where more consolidated directions are available to improve riders' conditions.

As a consequence, creative solutions, as the Motorcycle Clinic in Hanoi (below described), can be very appreciated because tailored on the real needs of the city, but in the same time easily transferable to other context.

Hanoi can be a typical example of a low-income Asian city, with problems due to a fast urbanization which is turning the city into a metropolitan area, an equally fast increase of motorcycle ownership during the 1990 – 2000 decade, a transit system in need of improvement and poor air quality.

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Few facts are sufficient to describe the local situation (Table 4), where PTWs are not only the dominant mode under the quantitative point of view, but also a mean to make a living.

Table 4 – Hanoi main figures (The Ministry of Industry of Viet Nam 2007, World Bank 2008)

Total number of inhabitants (2005)	3,145,000
Total number of cars (2005)	163,796
Total number of motorcycles (2008)	1,761,306
Average number of motorcycle/household (2005)	52 for every 1000 persons
Average number of motorcycle/household (2008)	497 for every 1000 persons
Motorcycle distance driven per person (2008)	7,250 km/year
Type of motorcycles (2008)	over 99% 4 stroke

This is the reason why motorcycles are expected to have a relevant role in the local modal share, even once the local transit system will be totally upgraded (Table 5) with the construction of a Urban Mass Rapid Transit – UMRT.

Table 5 - Travel Demand in Hanoi (The Ministry of Industry of Viet Nam 2007)

Mode	Number of trips (000/day)			Share (%)		
	1995	2005	2020	1995	2005	2020
Bicycle	2,257	1,598	452	73.2	24.6	4
Motorcycle	632	4,075	3,390	20.5	62.7	30
Car and taxi	7	226	1,808	0.2	3.5	16
Public transport	UMRT	-	4,294	-	-	38
	Bus, etc.	165	547	1,356	5.4	8.4
Truck and other	21	57	-	0.7	0.8	-
Total	3,082	6,503	11,300	100.0	100.0	100

Currently, other factors influencing the use of motorcycles, beside the poor transit supply, can be linked also to the compactness of urban areas with narrow access roads and lack of parking spaces namely in central areas, the general affordability and convenience of the mode also linked to poor maintenance levels, poor regulations (namely no helmet laws and lack of traffic signals, with negative consequence on safety: about 73 percent of all accidents involve motorcycle users, according to Hsu et al. 2003). It is not surprising then if air quality is poor, with air pollutants exceeding the national standards (World Bank 2008) and two-wheelers as the major source of emissions; indeed according to data collected at national level motorcycles accounts for 54.4% of total CO emitted, 54.1% of HC, 54.5% of Pb and 43.0% of dust (The Ministry of Industry of Viet Nam 2007, World Bank 2008). In 2005, a study to determine what might control PTWs ownership and consequently improve air quality concluded that a motorcycle taxation system could affect the regulation of the growth of ownership in a modest way and even the improvement of the bus service level would not lead to a great increase of bus share, which give the floor to technological solutions as the most effective means to decrease pollution in the city and namely inspection systems and attachment of catalysts, along with the improvement of the signal system (Shimizu et al. 2005).

A new initiative towards sustainability was launched in 2006 when a research by the Norwegian Trust Fund for Private Sector and Infrastructure assessed air quality impacts of traffic in the city, which paved the way for two major initiatives, the World Bank's Hanoi Urban Transport Development Project and the Hanoi Urban Transport Development Project, both aimed at improving air quality by a more stringent management; the Hanoi Center for Environmental and Natural Resources Monitoring and Analysis is the agency in charge of

coordinating the whole process and the so-called Motorcycle Clinic is the pilot project to start a specific inspection and maintenance program for motorcycles. Main activities of the Clinic are focused on the training of riders about proper maintenance practices (since 2007, 1,675 motorcycles have been “healed”) but the most important task is the collection of a huge amount of information “equivalent to an emissions inventory” which constitute a good knowledge base to support further actions to improve air quality. Moreover, the Clinic was important to evaluate the level of awareness towards sustainability among the riders: according to some surveys 94.4% of the interviewees “are aware that motorcycles pollute the air, 68.3 % think 10 year old motorcycles should be banned in the city, and 96.6 % are willing to pay for emissions reduction technology” (World Bank 2008).

Furthermore, in 2007 a \$155 Million fund was granted by the World Bank to promote an environmentally-sustainable transport in the city. The core of such project is the development of a Bus Rapid Transit System, including 37 km of segregated bus lanes and 9 km of bus priority along two corridors, its related facilities, the purchase of a fleet of 130 vehicles, along with a bus management system, with the specific goal to reduce the number of motorcycles/mopeds (Clean Air Net 2007).

Hanoi and its pilot project is a good example of a controlled experiment to monitor what might reduce motorcycles/mopeds within the framework of policies oriented to develop an air quality programme consistent with the population needs.

### **Poor knowledge of riders behaviors and motivation**

In general, a trivial but realistic reason to explain the widespread population of two-wheelers is their low-cost, and this becomes truer in low-income economies and or where transit supply is poor. However, this is not sufficient to explain such a diffusion of the mode, even in those areas where other variables as income, urban environment, quality transit, etc. should encourage users towards other modes.

In developed cities, such as Rome (further taken as a case in point to explain how strong the personal expediency can be in the use of the mode), economic constraints seem not to be an issue and reasons must be searched elsewhere. In such situations, the frequent keyword to analyze the success of motorcycles is “freedom”, but, leaving aside movie clichés such as “Easy Rider”, which do not represent the everyday life, more appropriate terms to define the phenomenon would be “attractiveness” and “convenience”.

The reasons why users are attracted to two-wheelers have been synthesized into three assumptions: no separation between rider and its driving environment, the vehicles’ smaller size and easier manoeuvrability (Yannis et al. 2007). Needless to say, good weather conditions contribute to enhance the first hypothesis, and this could explain the popularity of the mode in milder climates; the size factor can be crucial in urban areas with scarcity of road space and high population density, as already stressed when dealing with the environmental issue, but easier manoeuvrability is a tricky factor, which often conceals the underestimation of the skill required to drive a motorcycle, in spite of some recent important but contrasting experimental results (Savolainen and Mannering 2007). The always-too-high number of motorcycle fatalities and injuries, recorded worldwide, proves that.

Consequently, “convenience” seems to be an even stronger reason to explain the preference for the mode than the usually cited: weather, population density or cultural habits. Since “convenience” can be defined as the “quality of being suitable to one's comfort, purposes, or needs”, an explanation of the phenomenon based on personal motivations rather than exogenous factors seems reasonable. Such personal motivations are strong enough even to cast shadows on important issues such as safety and environmental concerns.

Thus, two-wheeler drivers are actually aware that motorcycles are more dangerous than cars, so that they perform a potentially hazardous activity. Their safety largely depends on their own behaviour (Avenoso and Beckman 2005), but they tend to marginalize the risk significance because they have a strong belief in their riding ability (Natalier 2001). They even tend to develop their own concept of risk, very close to what has been described by the theory of risk homeostasis: indeed, most riders are convinced to have a kind of fixed level of acceptable risk, i.e. an own “decision making skill for risk reduction” (Wilde 2005).

There are similarities observed in existing mixed-traffic situations, recurring patterns in Taiwan, Malaysia and Vietnam (Hsu et al 2003) which are typical of Mediterranean areas as well. They include risky or offensive behaviors, freedom to park everywhere, tampering engines to go faster and the ability to weave through queues in congested situations. Such driving and/or manoeuvring flexibility simply responds to the need to move fast, in spite of safety. It is not a product of cultural processes, because they are found in such different areas, and it is not affected by peculiar weather conditions.

Last but not least, it has been stated that “motorcyclists learn by observing and interacting with other motorcyclists” (Njå and Nesvåg 2007) and this is maybe the key element to explain, on the one hand, why risky or offensive behaviors are so common and reiterated and, on the other, why such behaviors occur, i.e because of the decision-makers' unconcern on the PTWs users needs, resulting thus into poor attention to training and educational dedicated programs for riders. This also why “Education/training/road safety awareness/ long life education” is one of the most recurring key problems among a list of 42 identified by 39 Countries during a survey circulated by the Joint Transport Research Centre Secretariat to all the OECD/ECMT member Countries (Joint OECD/ECMT Transport Research Centre 2006).

### *Personal Convenience: an unusual lesson from Rome*

It is clear, then, that as long as poor attention will be paid to investigate relations among safety, risks and social and economic factors, recurring behavioural and motivational patterns will remain undisclosed and safety policies for riders will not progress, being anchored only to statistical data, which are important but not sufficient to promote safety programs and measures accepted among the riders communities.

The Rome case study reflects contradictions and efforts to manage a popular mode of transportation, whose attractiveness could contrast with environmental concerns, as well as the importance to have a proper knowledge of riders behaviors and motivations.

The city's motorization rate is one of the highest in Europe: 950 vehicles (two-wheelers included) per 1,000 inhabitants (including the infant and senior populations), as recorded in 2005 (ATAC 2006). The number of two-wheelers in 2007 amounted to 535,839 units.

*Motorized two-wheelers:*

*contrasting aspects, recurring problems and solutions for more comprehensive urban policies*  
MUSO, Antonio; CORAZZA, Maria Vittoria

One explanation for such a high motorization rate is due to the city form: the ancient, historical city center has narrow streets and its semi-central areas and suburbs are connected by only two underground lines and a large bus network. This transit system is not able to meet Roman citizens' demand in a satisfactory way and therefore in the last decades citizens have become addicted to private vehicles, leading to a consequent increase in the number of cars and two-wheelers. The former represents 77.4%, the latter 13.1% of the total motorized vehicles registered in Rome (ATAC 2006).

The role of two wheelers in the local modal split did not markedly changed in the last few years. Indeed, the urban modal split in 2002 was: 30% transit, 27% private cars, 23% motorbikes/mopeds and 20% pedestrians. According to the 2005 estimations, these proportions have changed to 31%, 22%, 24% and 23%, respectively. The five point decrease (percentage) for private cars in favor of three point increase (percentage) for walking can be considered a noteworthy result and it suggests that citizens reduced their use of the car for trips of short distances, even though scooters and motorcycles still represent a good option for motorized trips (Musso and Corazza 2006b).

If data are analyzed at the provincial level and all the systematic trips are considered (either to reach work or school places) during the 1991 – 2001 decade (i.e. when the two national census surveys occurred), transit decreased by 29.9%, car passengers increased by 43.3% and car drivers by 6.7%, but above all two-wheelers increased by 107.2%. Moreover, more than half of the overall amount of trips by two-wheelers occurs in a distance range between 2 and 11 km (as for cars) and even for walking distances (0 to 1 km), the use of mopeds and motorcycles is still an option (ATAC 2006).

The attractiveness of the mode has been tested also when simulating the application of pricing policies for some popular districts in Rome: the goal of the simulation was to individuate the level of charge for cars which compelled drivers to switch to transit. As expected, transit progressively increases and cars strongly decrease as charges increase, but these changes could be appreciated only in the event of very high - and not realistic - charges (respectively 32 € and 64 € per trip for cars) when cars share switches from 11% to 8%; being two-wheelers not charged a kind of natural switch to the mode was observed among those drivers more "transit-resistant" (Figure 5).

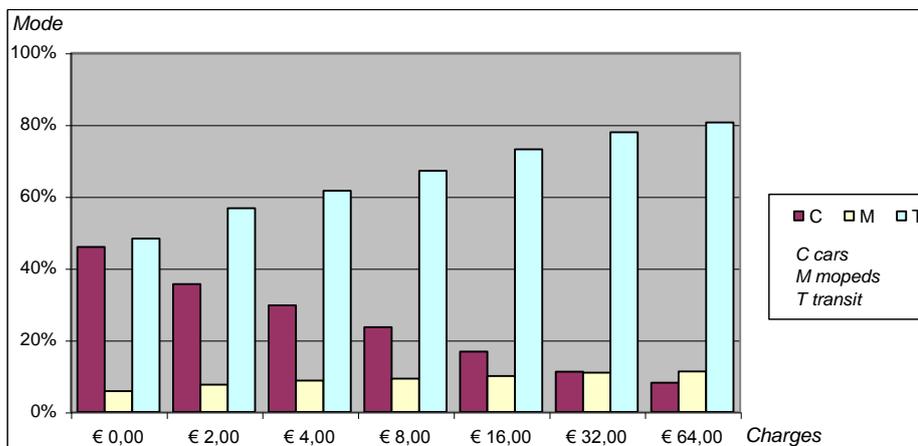


FIGURE 5 - Simulation of a pricing policy in a Roman district: variation of modal choice according to different charges for cars.

*Motorized two-wheelers:*

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Charging two – wheelers could produce a 20% reduction in the use of the mode in favour to transit in the event of the equally very high - and not realistic charge of 1,5 € per trip, being such a rate not even politically-conceivable since PTWs are the most popular mode for hanging out among young people in Rome (Musso and Corazza 2006a).

The local, cultural and political approach can help explain such figures. On the one hand, local administrators avoid dealing with two-wheelers in a proper way, as demonstrated by two pieces of evidence: the unrestricted access to the city’s Limited Traffic Zones (LTZs) and the free on-street parking, whereas in both cases car drivers are charged; on the other hand, two-wheelers are a kind of status symbol citizens are not willing to give up, as further described.

As a consequence of such political choices, mopeds and motorcycles accessing the city centre LTZ are more than cars (Figure 6) (Musso and Corazza 2006a), the number of free parking places for two-wheelers across the whole urban area is not even comparable to what the real demand requests, since there is about 1 parking place available for every 14 two-wheelers (turning sidewalks into the most convenient parking facilities for mopeds); motorcycles play a major role in the production of pollutant emissions, being as “dangerous” as cars in terms of CO emissions, and far from negligible for what concerns particulates and NMVOC. In particular, simulations estimated that PM emissions due to two-wheelers are about 26.2% (morning peak hour) and 26.6% (average working day) of the total amount of PM emitted in central areas (Rome Municipality 2004).

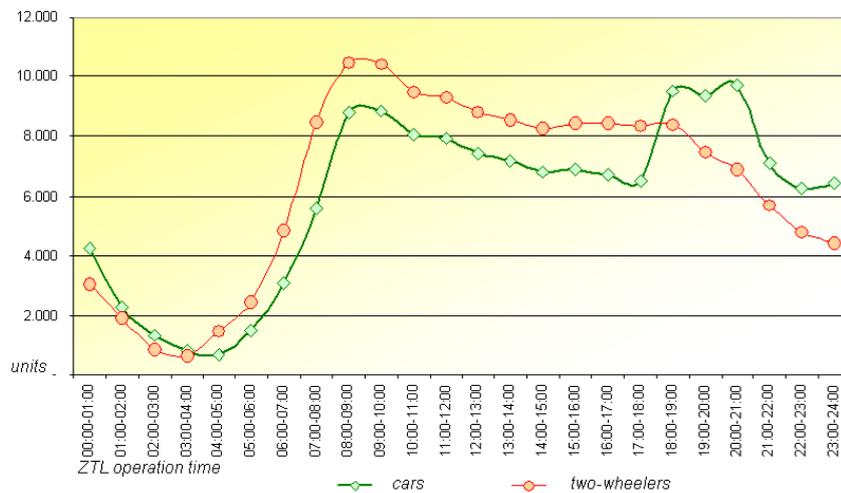


Figure 6 - Passenger cars and two-wheelers accessing the city centre LTZ, average day

Poor air quality remains even though the yearly inspection of vehicle emissions and compulsory servicing of motorcycles and mopeds are in force since few years, but the fact that two-wheelers are regularly left out from any other initiative concerning traffic restriction is a sign of the permanent underestimation of the problem at the political level.

The lesson learned from the electric scooters (or e-scooters) experience is another example. In 2000 the Municipality decided to support the usage of e-scooters and to set up suitable recharging points in the city central areas. Moreover, the Municipality advertised the benefits

of electric vehicles in general using dedicated campaigns and allocated funds to prompt people to purchase electric bicycles, cars and e-scooters.

Mainly, the aim of the measure was to promote the use of e-scooters, due to the environmental concerns regarding PM<sub>10</sub> emissions.

Accordingly, Rome Municipality acquired a small fleet of 398 e-scooters in the same year. In 2001, a special dissemination activity was undertaken with tourist services, non-profit organisations and the general public and the results, in terms of possible acceptance, were encouraging. The 398 e-scooters were initially available for rental, but soon the public participation in the initiative was very low. Subsequently, some e-scooters were transferred to administrative units of the Municipality to be used for specific, regular urban trips, while 200 were transferred or donated to non-profit organisations. The recharging points became useless and soon turned into spontaneous, free parking places.

The reasons of the failure are manifold, and the simplest is that, after the initial dissemination, no further advertisement or education activities occurred. People simply forgot, remained sceptical about e-scooters or did not find them convenient, because they are not comparable in terms of performance with traditional scooters. Such limited performance revealed the principal barrier to the implementation of e-scooters: i.e. the limited batteries life, which casts doubt on the possibility of implementing these vehicles on a larger scale. Recharge operations proved to be a limit themselves: the time required to recharge batteries (roughly 6 – 8 hours) also prevented the measure from becoming accepted.

Such a gap between the local administrators' goodwill and the citizens' unconcern prompted the former to start looking for the reason of the failure, but above all to understand recurring motivations in the use of PTWs. A survey run in Rome in 2007 aimed at profiling typical local two-wheeler users was decisive to determine that the two-wheels option is a result of individuals' will rather than external factors. According to the interviewees, main purposes to travel by motorcycles/mopeds are: work (53%), leisure (34%) school and errands/shopping (14% each). Moped riders assess favourably transit and especially the underground, but if the overall population of two-wheeler users is considered, 44% state that before riding they used to travel by bus and 35% by car and the reasons to switch to two-wheelers is due to the mode's highest speed which allows surfing in the city traffic (53%), ease (46%), easy parking (24%). The other answers (Figure 7) still imply the personal convenience as the main motivation to switch to motorcycles and mopeds. It is worth noticing that low cost is not a top priority, since according to drivers' and riders' statements, the annual maintenance costs for two-wheelers are higher than those for cars (respectively about 0,31 and 0,22 €\*km) (IAC 2008).

Pros and cons of riding, as revealed by the interviewees are consistent with the reasons which induced them to leave cars and transit; among the pros, again, speed, possibility to surf in traffic, easy parking are still the most favourably assessed issues. Moreover, moped drivers state that they like the fact that there is poor enforcement towards offending behavior. On the other hand, motorcyclists feel persecuted by control and enforcement officers and misjudged by other drivers. Other negative aspects shared both by motorcycles/mopeds riders are smog and poor road safety.

When asked about what they feel when riding, interviewees provided a number of motivations, virtually all not dependent on any economic concern. In particular they state

that, as riders, they “pollute less and risk more”. Such an answer reveals, on the one hand, a total unawareness of the role played by two-wheelers as polluters (confirmed by the amount of riders whose vehicles are not compliant with the “clean vehicles” standards, about 41%). On the other hand, it is a kind of “egocentrism” which goes in hand with the feeling of almightiness and privilege revealed by the previous answers.

Roman citizens, in their turn, largely agree with the negative assessment perceived by moped drivers: according to a survey run in 2005, Romans judge them as the greatest offenders of traffic rules

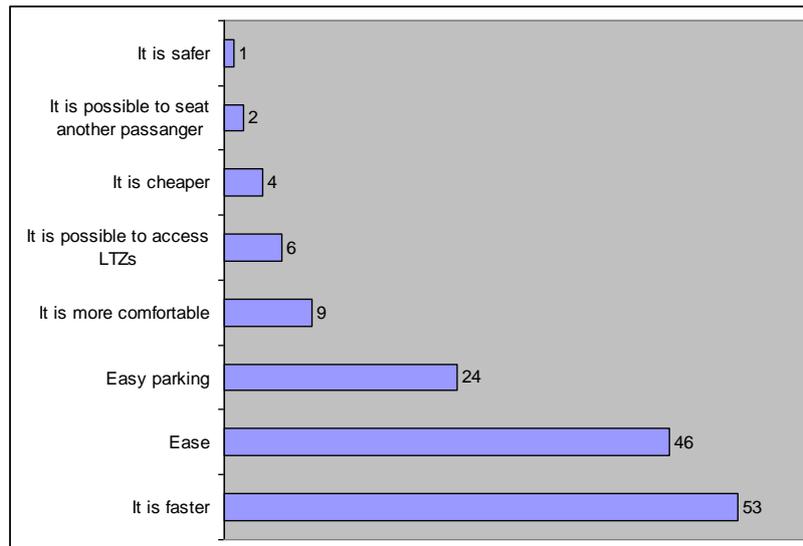


Figure 7 - Reasons among the interviewees to switch to two-wheelers – in percentage

Psychologists provided an interesting interpretation of the collected statements: riding in Rome is perceived as a “challenging, transgressive activity”, which allows individuals to express themselves freely, dominate the urban environment and feel as one with their vehicles. But transgression, challenge and misbehaviours are consistent with a shared feeling among the Romans who perceive the mobility situation in the city as in a state of “anarchy”, with no possibility to improve or trust administrators (Musso and Corazza 2006a). Hence, the Rome case study demonstrates that, in absence of economic reasons, the motivation of two-wheeler riders is influenced by the individuals’ convenience, regardless of any safety and environmental issues, and it is not strongly affected by the quality level of local transit.

### **The lack of comprehensive mobility policies**

Integration, intermodality, sustainability, incentives to collective and non-motorized modes are some of the pivotal concepts *sine qua non* mobility management policies are destined for failure, but in spite of the above mentioned concepts, two-wheelers seem to loom in such a framework.

Once more, reasons must be searched in the local mobility patterns, where two kinds of scenarios seem recurring. The first one is representative of a situation in which transit performance are not satisfactory, or the transit system itself is nonexistent, two-wheelers are

along with cars the dominant modes, or just the prevailing one even with functions typical of collective transport (taxi-rickshaws, for instance). On the contrary, in the second scenario quality transit and high private cars ownership rates represent the core of the mobility pattern, even though two-wheelers are not negligible under the quantitative point of view. The latter situation is a snapshot of many urban areas in developed Countries, whereas the former is representative of cities both in developing and industrialized Countries, but exceptions, as further described, are possible.

Anyway, for both situations, policies and strategies, so far implemented, have been targeted to achieve intermodal balanced transport systems where “balanced” means, mostly, for the first scenario to have transit just gain momentum and for the second one to prevent the amount of private cars from increasing. This is why measures based on incentives to attract passengers to transit (for example quality corridors, clean fleets, commuting programs, etc.) and disincentives to the use of private cars (access restriction, pricing, pedestrianization, just to mention the most common ones) abound under these circumstances. Needless to say, the involvement of PTWs is quite rare, being the mode assessed by decision-makers as either not a priority (in the first scenario) or too sensitive a target (in both scenarios) to gain consensus.

However, both approaches are correct and consistent with the need to solve general problems related to safety, environment, equity issues, but short-sighted or rather “easygoing” since, on the contrary, they leave aside a traffic component as PTWs which, as seen before, plays a not secondary role in generating such problems. Obviously, it would be politically unjustifiable to take only measures to inhibit motorcycle use and pressure travelers into public transportation if no corresponding measures are taken to inhibit car use or increase transit quality, nor would be reasonable to keep on underestimating the role of two-wheelers because any governance action can be perceived as not politically winning.

The inclusion of measures to manage PTWs, along the collection of data to have a proper knowledge about them, is therefore essential to progress towards really comprehensive mobility policies; considering this mode according to its actual role and potential will pursue a twofold goal: to steer the modal share towards a real intermodal balanced system and improve local safety and environmental conditions. This is not a straightforward process since cultural habits, technical procedures and regulatory issues need to be adjusted and/or revised in many Countries to have two-wheelers included in the ordinary mobility management practice, but should such a process not occur, two-wheelers will keep on contributing to pollution, poor safety and low quality of life in many urban areas.

#### *A creative form of transit: the mototaxismo in Bogotá*

The case study of Bogotá is a mix of both the aforesaid scenarios, and therefore can be seen as an exception to those standard situations; however, in the same time, it represents a clear example of how the underestimation of the role of PTWs in the everyday mobility pattern can give rise to some alternative operations to transit, even though not very efficient in the long term.

At the end of the 1990's for the city started a kind of Renaissance period due to a new transportation policy, the so-called Transmilenio program, undertaken by the local

administrators, whose aim was to provide Bogotá with a user-oriented transportation system. The challenge seemed hard to face for the city, one of the most densely populated in the world (8,566,926 inhabitants in 2009), because of the long-time lack of effective policies to manage the local mobility problems. The new policy was based on several measures acting on different fields, from road maintenance to rehabilitation of urban areas, from strengthening the roles of transit and non-motorized modes (namely due to the construction of new busways and bike routes) to restrain private cars use (Ardila and Menckoff 2002). Consequently, the city can be regarded as a positive model, having the 2005 modal share as follows: 57,2% transit, 17,3% non-motorized modes, 14,7% private cars, 0,7% motorized two-wheelers and 10,1% others (Camara de Comercio de Bogotá 2008); even the motorized vehicle ownership rate is rather low, about 73 cars every 1,000 inhabitants (Urban Age 2008b), but regardless of such official data, the number of motorized two-wheelers skyrocketed in the last three years, currently amounting to about 400,000 units. Low taxation, affordable prices and, above all, the enforced access restriction to central areas for private cars, are the main factors which made the usage of two-wheelers escalate, with no regard to safety problems. Needless to say, the number of fatalities involving riders is ranked second (after car drivers and passengers) in the overall fatal accidents statistics. On the contrary, the awareness about the environmental problems forced the local authorities to issue some new regulations: from the prohibition for two-stroke engine mopeds to circulate, to the requirement for the newly-registered vehicles to be compliant with the Euro I (from 2010) and the Euro II (from 2011) standards.

Nevertheless, the attractiveness of motorized two-wheelers has become so strong and made them competitive with transit, that it gives rise to the so-called “mototaxismo”: the use of motorcycles as informal taxis, with fares that are negotiated before starting the ride. Surveys show that low operating speed and high fares, combined with the faster ride in the congested traffic seem to be the two key aspects which cause some travelers perceive the “mototaxi” as a substitute of the bus.

To fight illegal operations and improve safety for passengers and drivers (the latter are easily recognizable because they have a second helmet secured to the arm), recently a regulation has been introduced, specifically aimed at formalizing the business, which in the meantime has become more and more popular in other Colombian cities, too. Accordingly, private companies can now operate “mototaxi” services in any city with less than 50,000 inhabitants. It is clear that the legalization of the “mototaxismo” in low demand areas is an attempt to provide citizens with an alternative transit system in contexts where transit would tend to be neglected; but it is also evident that it cannot be exportable to larger areas, because it can become a kind of “unfair” (and “unsafe”) competitor to the traditional transit modes: flexibility of rates and routes, solo-transportation has successful features which make it difficult to convert the “mototaxismo” into a proper transit system in spite of its initial success.

## **LOOKING FOR MORE COMPREHENSIVE URBAN TRANSPORTATION POLICIES**

The importance of a proper assessment of the role of two-wheelers in the urban mobility management is the core of the lesson learned from all the case studies above described.

Barriers as the underestimation of the problem, lack of dedicated policies, poor awareness and missing involvement of the end-users can be overcome with synergic efforts, according to three main directions:

- revision of the decision process, both at institutional and at regulatory levels;
- technical progress to develop not only more and more efficient safety measures but also transferability practice to “export” good, consolidated results;
- cultural challenge involving decision makers, road users, planners and designers.

## **Revising the decision process**

The revision of the decision process is a kind of pre-requisite for the development of the other two issues, since political will (and hence resources) along with comprehensive and updated regulatory tools are imperative to start a new vision for PTWs. So far, decision makers have been rather reluctant to deal with two-wheelers, focusing only on safety problems when facts and figures have become unbearable; in the same time regulatory tools (from highway codes to master plans), being based on the generally acknowledged “dominant” mode, i.e. the private car, are far from providing rules for two-wheelers as stringent as those for cars (the missing enforcement of compulsory helmets or low wearing rates in some Countries are a good evidence).

The right response would be the creation of dedicated national agencies with local branches able to enforce regulations and related tools, guarantee control procedures, promote studies and regular statistical surveys, support awareness and communication campaigns, train technicians and practitioners on any issue concerning two-wheelers: safety, environment, health, etc. Needless to say, to avoid partial or not satisfactory outcomes infrastructure, vehicle and human factor have to be equally tackled for any of the issues above.

Under this point of view, some recent regulatory tools entirely dedicated to PTWs seem to address the problem in a very effective way: the already mentioned British “Government’s Motorcycling Strategy” by the Department for Transport issued in 2005 and the Spanish “Plan Estrategico para la Seguridad Viaria de Motocicletas y Ciclomotores” issued in 2007 by the Ministerio del Interior at national level, or the 2001 “Motorcycle and Scooter Strategy and Action Plan” by the City of Sydney, at local level, provide guidelines to face a wide range of problems (environment, land use, awareness, etc.), even though the emphasis is on safety.

From such documents it is clear that both central and local levels are required since the bottom-up approach is essential to promote local best practices or pilot projects into contents for national guidelines, but the top-down process is equally important in terms of standardization of data, enforcement of general rules, validation of results, assessment of drivers and barriers.

## **Technical progress and transferability**

Technical progress means that concerted actions must be undertaken to improve infrastructural and on-board safety levels, and the set-up of safety audits, especially targeted to riders problems, is maybe the most important step forward. But progressing in this field means also improving the knowledge of behavioural patterns: reasons behind recurring types

of offences, risk perception, user problems per gender, age, income are typical issues whose analysis is of the utmost importance for three main reasons: it can be helpful to improve safety devices in relation to users needs and attitudes (for instance “glam” helmets can become appealing to young people, turning a regulatory requirement into a “must-have”); it can be useful to steer design towards the solution of recurring conflicts among all the road users, and namely the vulnerable ones (the design of crossing areas to accommodate both pedestrians and riders is still far from an appropriate solution); it is necessary to “tailor” regulations to some kind of users and habits (very different issues may arise, for example: senior riders demand the same attention as novices, but so far no attention has been paid to them; but also, can PTWs be used to plan commuting programs?). The technical gap between developed and developing Countries is undeniable and it is clear that state-of-the-art measures, as for example the ITS-based ones, cannot be expected to be part of short-term safety or mobility managements programs in those Countries where safety basics are still missing; but such a barrier must be seen as an opportunity to improve transferability methods to adjust measures successfully adopted elsewhere to local needs and circumstances.

### **A cultural challenge**

The third direction is maybe the most difficult, since a cultural (and behavioral) challenge involving decision makers, road users, planners and designers calls for a long-term process; indeed increasing awareness and reaching consensus are based on reiterated actions aimed at involving step by step larger parts of audience, along a way paved with misunderstanding, prejudice or simply poor knowledge (and this is not a figure of speech, since it is irrefutable that in many developed Countries, in spite of a mature awareness among the politicians, the public perception of the “safety problem” is still quite feeble). It is important, therefore, to build the process counting both on quantitative and qualitative resources. As a matter of fact, the bigger the group of road users, planners, designers and decision makers involved, the higher the probability to reach the goal of having shared decisions and strategies; but the contents behind public awareness campaigns, training programs or pilot experiences to improve riders conditions must be conveyed with advanced communication means, which are not merely expensive business operations, with commercials soon forgotten once TV is switched off. The already mentioned statement “motorcyclists learn by observing and interacting with other motorcyclists” is once again important since sheds a light on the importance of having role models with the same everyday experiences of the target audience. Accordingly, “advanced communication means” can be a community of very different users: official teaching staffs, volunteers from NGOs, local administrators, web users, technicians, media people, manufacturers, i.e. a mix of civil society, institutional bodies and business people able to talk directly to riders and to help them to become a real pressure group. The role of the web will be essential in this process, provided to be constant and reliable.

## CONCLUSIONS

Underestimation of the role played by riders in traffic planning activities and everyday mobility management is the main cause of disproportionate numbers of accidents, nuisances to the community, environmental damages, detriment to the overall life quality.

As long as PTWs will not be properly considered as any other mode by both politicians in the decision process and technicians in mobility planning and management the probability to achieve a real intermodal balanced system will be rather remote.

A revision of the decision process, more technical innovations and above all a behavioural challenge, as above described, are required to reverse such a trend. This is a long-term process but necessary both for developing and developed Countries if efficient measures to improve safety, fight pollution and in general reduce externalities are imperative. When dealing with two-wheelers, there are no recipes to steer policies towards a more balanced modal share and even the usual “push and pull” approach, i.e. promote transit and discourage private motorized modes, can turn out to be tricky if the role of two-wheelers is not properly assessed in the everyday life. It would be unfair to simply restrain two-wheelers in developing Countries when they represent the dominant mode to commute; in the same time, in developed Countries it may actually prove counterproductive, if the result is a significant increase in cars use, even though issues as pollution and safety may arise.

As with any other transportation mode, the policy should not be the same in every urban area, but efforts to have successful measures easily transferable from one city to another are necessary not only to provide users with technically efficient measures, but above all to create acceptance and awareness at community first and at national level, then.

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