Accidents analysis on bicycle network in the Municipality of Florence

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1. DATA AVAILABLE AND INITIAL TOOLS

DATA ACCIDENTS: The accident data was extracted as opendata provided by the Municipal Police of Florence, between April 1, 2011 and March 31, 2015, in which one or more bicycles were involved as driving vehicles. All relevant information, such as date, location, severity, etc., has been used.

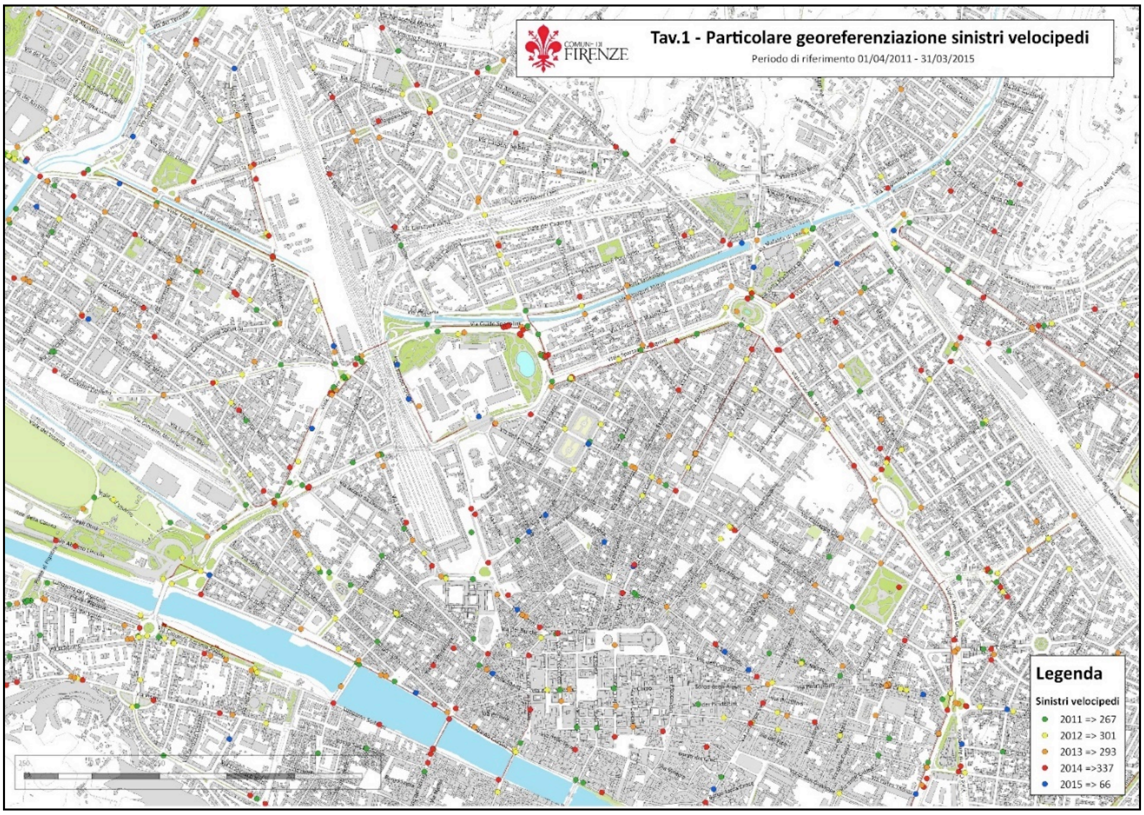


Figure 1 – (QGis) particular information system used for analysis

NETWORK CYCLING POINTS: All those already in operation on March 31st 2011 and those realized in the next five years have been identified (see Table 1).

Reference period	Urban Biicycle Network [Km]				Trails in River Area		Trails within parks and gardens	Cycle Network Development	Cycle Network in operation (Km)
	roadside (marked)	Mix (bike/ pedestrian)	Marked roads	Marked on sidewalk	River bank	mixed	park		
Ante analisi	17,946	12,412	1,195	14,016	9,775	0,000	19,218	74,562	74,562
2011	1,273	0,659	0,267	0,115	0,000	0,000	0,000	2,314	76,876
2012	1,779	1,528	0,032	1,755	0,266	3,168	0,000	8,529	85,405
2013	1,778	1,829	0,351	0,269	0,000	0,000	0,000	4,227	89,632
2014	1,055	1,719	0,056	0,509	0,000	0,000	0,000	3,339	92,971
2015	0,000	0,408	0,000	0,234	0,000	0,000	0,000	0,642	93,613

Table 1 – Evolution of the cycle network in referring period

Depending on the position of the cycle lanes, it was possible to implement the informations about accidents, connecting them considering the position of the bicycle network (in correspondence, adjacent or within distances up to 100 mt, 200 mt, 300 mt, 400 mt and 500 mt) and intersections (bicycle and generic).

BICYCLE CIRCULATION: In order to provide a Source-Destination matrix for bicycle trips, ISTAT Census data was used in 2011, which provided the origin and duration of the itinerary and zoning of the City of Florence in 21 areas defined as ACE.

In collaboration with Bloomberg Philanthropies, the average speed of bicycle users was set and then the destination was distributed, assuming that the main direction of the trips, being mostly for job purposes, was towards the city center. In this way it was possible to assign the target area and complete, even with a margin of error, the O / D matrix.

	Destination Area																					**Total Origin**
	11	**12**	**13**	**14**	**21**	**22**	**23**	**24**	**25**	**31**	**32**	**41**	**42**	**43**	**44**	**51**	**52**	**53**	**54**	**55**	**56**	
11	420	20		360					6													**806**
12	260			843															10	30		**1.143**
13			662	306													25	10				**1.003**
14		258		553		33								6								**850**
21	32	665		354										19								**1.070**
22	13	255		18		405								3								**694**
23				29			380					1			7		278					**695**
24	4	19		9	221				434													**687**
25	4	22		13	277				293													**609**
31	8	230		41						318												**597**
32			130	18							229					3	11					**391**
41		6		23								120			160							**309**
42	134	11		17									108									**270**
43	298	73		308		16																**695**
44				291			49								350							**690**
51			4	15												216	206					**441**
52			451								40						487					**978**
53			10	11													155	187				**363**
54	30			10															251	125		**416**
55	159	3		14				4												185		**365**
56	143		4	19							2										210	**378**
otal stinati	**1.505**	**1.562**	**1.261**	**3.252**	**498**	**454**	**429**	**4**	**733**	**318**	**271**	**121**	**108**	**28**	**517**	**219**	**1.162**	**197**	**261**	**340**	**210**	**13.450**

Table 2 – Reconstruction matrix O/D

2. **ELABORATION AND ANALYSIS OF OBTAINED RESULTS**

CORRELATION ACCIDENTS - CYCLING NETWORK

In Table 3, accidents were divided based on their position with respect to the presence of cycling lanes (in yellow incidents involving mortals, each death is represented by *).

TRIMESTER	Accident Position	2011	2012	2013	2014	2015
January - March	On bike lane	n.d.	10	8*	11	14*
	Next to	n.d.	8	10	10	8
	No bike lane	n.d.	61*	45	45*	44
April - June	On bike lane	14	10	13	25	n.d.
	Next to	16*	10	9	6	n.d.
	No bike lane	68	57	49	76	n.d.
July - September	On bike lane	8	7	8	15	n.d.
	Next to	8	11	13	6	n.d.
	No bike lane	66	52*	55*	60**	n.d.
October-December	On bike lane	12	8	13	16*	n.d.
	Next to	10	11	13	4	n.d.
	No bike lane	65**	56	57	63	n.d.
TOTAL		**267**	**301**	**293**	**337**	**66**

Table 3 – Accident locationing

It is noted that the trend of accidents involving bicycles - in the period 2011-2015 - is almost constant. Most of the accidents occurred on roads without bike lanes ; but comparing the number of accidents on bike lanes and those on roads next to adjacent bike lane is very high, so to be almost comparable. With regard to deaths, out of 12 reported, only 3 (one in 2013 and two in 2015) occurred on a bike lane.

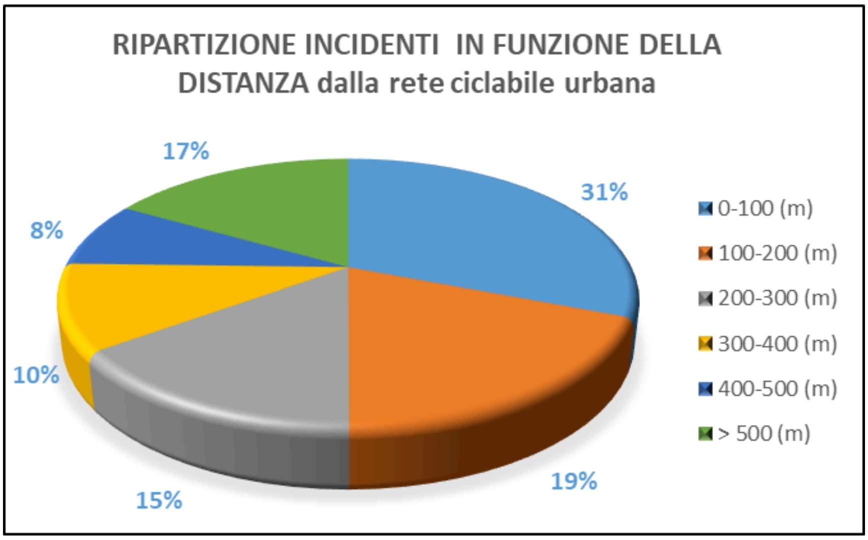
Table 4 shows the number of accidents occurring at the intersections or where it is possible to expect a conflict with the other components of the city traffic (in yellow accidents involving mortals, each death is represented by *).

TRIMESTER	Accident Position	2011	2012	2013	2014	2015
January - March	On bikelane crossing	n.d.	8	5*	7	6*
	On other crossroad	n.d.	30*	33	23*	20
April - June	On bikelane crossing	10	7	8	16	n.d.
	On other crossroad	36	32	28	37	n.d.
July - September	On bikelane crossing	5	3	7	7	n.d.
	On other crossroad	35	27*	32*	28	n.d.
October - December	On bikelane crossing	8	2	10	16*	n.d.
	On other crossroad	33**	34	37	40	n.d.
TOTAL		127	143	160	174	**26**
% on global accidents		**47,6%**	**47,5%**	**54,6%**	**51,6%**	**39,4%**

Table 4 – Accidents on crossroads

Compared to the totality of the accidents examined, almost 50% occurred at an intersection or crossing. Considering the intersection typology, most accidents do not occur on bicycle crossings. As far as deaths are concerned, of 12 reported in the reference period, 9 (75%) occurred on an intersection area.

In Picture 2 accidents are shared considering distance from the urban cycle network: in a systematic way for all years in this study, about 30% of accidents occur within 100 mt from a bike lane. This index confirms that 30% of cyclists who want to use the bicycle network are about 100 meters from the existing bicycle network and, before arriving, an accident occurs to them. It is assumed that there is a willingness to use it because otherwise the data would be distributed more evenly over the distances examined. This could mean that that the bicycle network present on the main routes, should be made more widespread on approaching neighbouring roads.



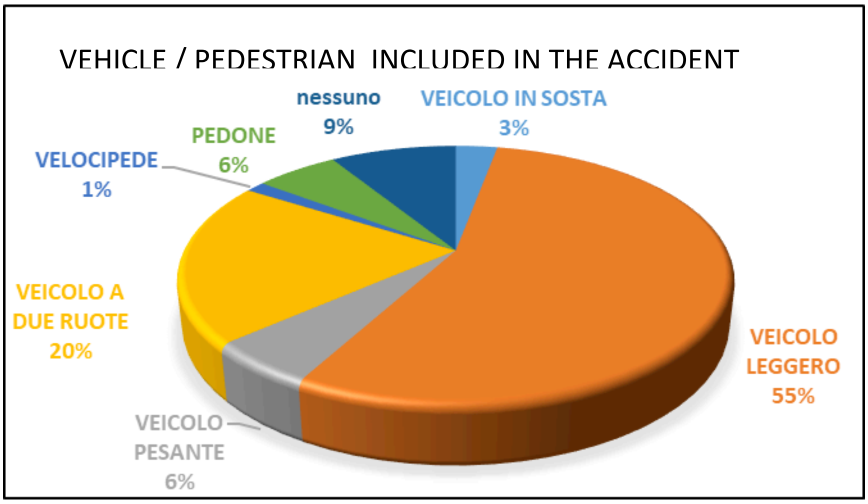
Picture 2 – cumulative percentage for the reporting period

/DISTRIBUTION OF ACCIDENTS CONSIDERING THE DISTANCE FROM URBAN CYCLING NETWORK/

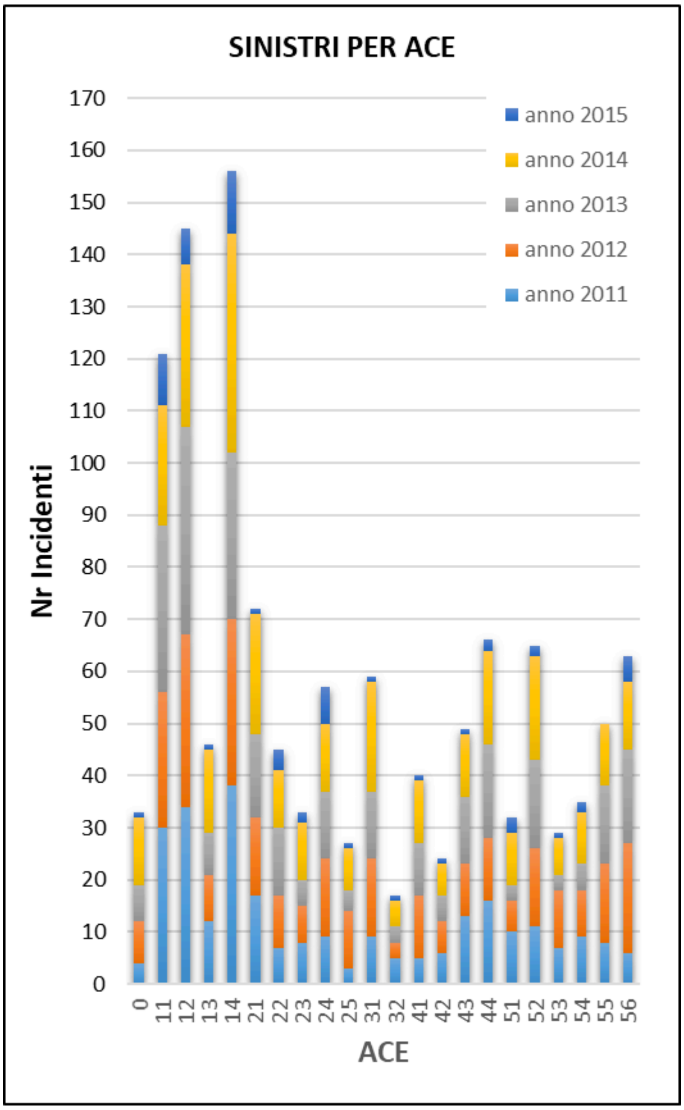
ACCIDENTS CONNESSION - TYPE OF VEHICLES

In order to consider accidents with at least one bicycle involved, consequently it was found the type of the second vehicle involved in collision.

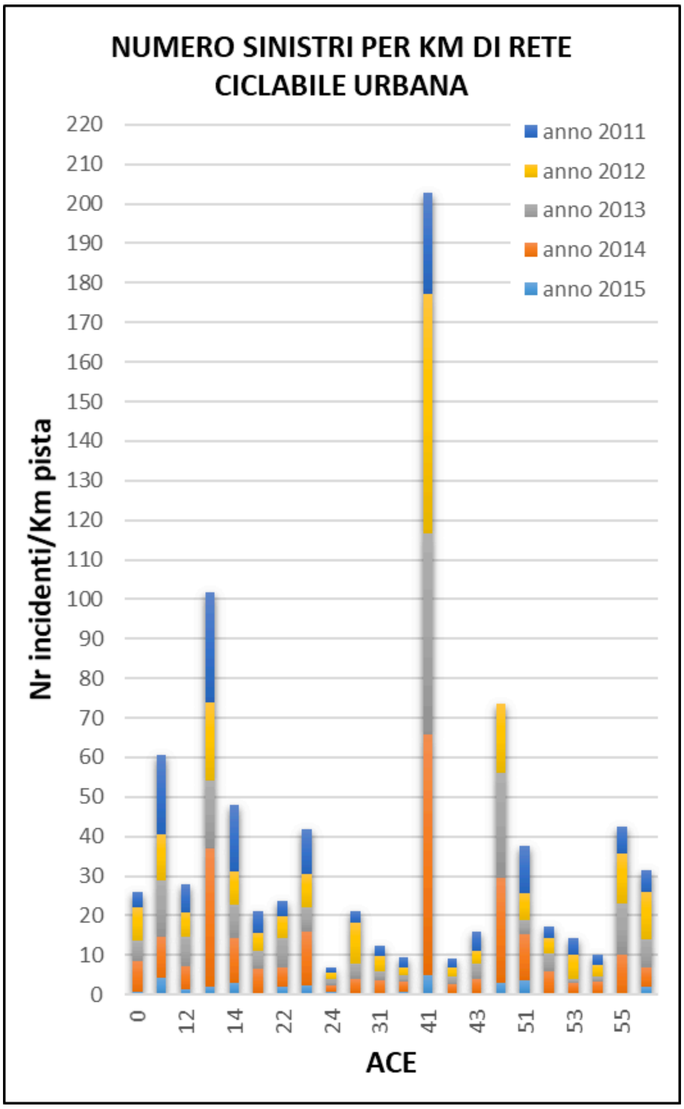
Picture 3 shows that more than half of accidents occured by bicycle are caused by a collision with light vehicles (cars) and a 20% with two-wheeled-vehicles (motorcycles and scooters). On the contrary, collision between 2 bicycles have a very low percentage and rather a small number concerning collision between a bicycle and a pedestrian.



Picture 3 – Percentage considering the second vehicle involved



Picture 4 – Number of accidents for ACE



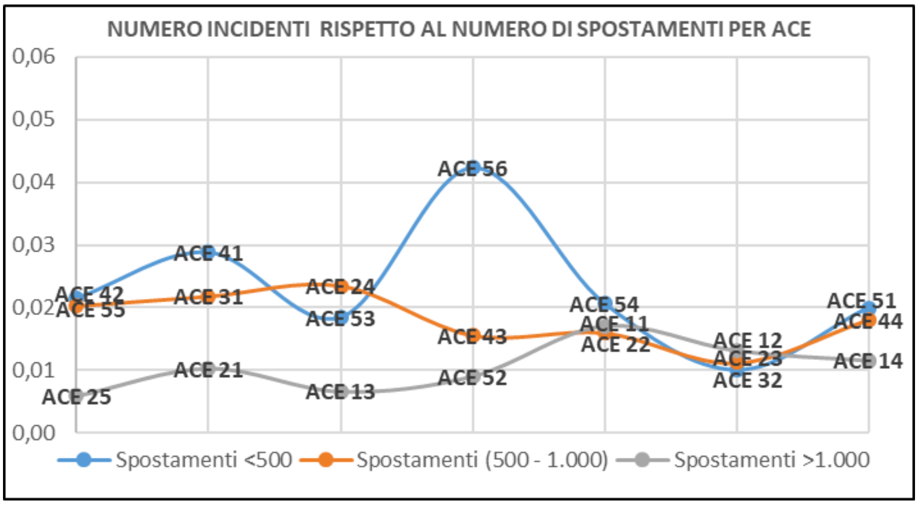
Picture 5 – Nr accident on km bike network

Picture 4 shows the number of accidents divided by year and by ACE in which it occurred: by analyzing the data, it can be seen that in the center areas (ACE 12 and ACE 14), which approximate to the inner circle of the wall of Florence, there have been the largest number of accidents.

However, the following areas are still very serious: ACE 11 (area between Viale Redi and the Cascine Park), ACE 21 (area between the railway and Viali di Circonvallazione), ACE 44 (Soffiano / Legnaia), ACE 52 (Statuto), ACE 56 (Florence Nova).

In Picture 5 it is possible to evaluate the number of accidents in relation to the kilometers of cycling network in each area, shared by year. By analyzing these values it is noticed that the most peripheral areas often have the highest values respect to Castrum. This factor means that, with a large number of accidents, there are a few kilometers of bicycle network available. In particular, it should be noted that the areas are: ACE 13 (Oltrarno), ACE 41 (Bridge to Greve), ACE 44 (Soffiano / Legnaia).

In Picture 6 it shows the report between number of accidents and number of transits, shared by year and by ACE (ACE were divided into 3 categories based on the number of transits in order to understand better the results by comparing the values between ACE with similar number of itineraries .



Picture 6 - number of accidents considering itineraries.

3 . CONCLUSIONS AND PLANNING TO TENDER

Although this is a preliminary study, it can reasonably be highlighted how some critical issues appear, mainly linked to accidents on intersections (whether they are cycling or generic); to the diffusion and distribution of the cycling network; to the implementation of existing datasets; to the lack of information to put into the data system.

From the comparison of the results shown in Picture 4, Picture 5 and Picture 6, a prioritization of the most dangerous ACEs has been created in terms of cycling accidents linked to the km of available bike lanes and the number of itineraries, which can be schematized as in the table : the Goals that the Florence Municipal Administration aims to pursue are **the reduction of accidents in wider terms** starting from the protection of so-called weak users (cyclists and pedestrians); **a sensible increase in the whole cycling system all over Florence**, which, due to its particular shape and size, is particularly suitable to this type of mobility; an **incentive to change the transport habits,** orienting and increasing people towards the use of public service and bicycles.

ACE	AREA
41 – PONTE A GREVE	4
11 – VIALE REDI/CASCINE	1
13 – OLTRARNO	1
44 – SOFFIANO/LEGNAIA	4
56 – FIRENZE NOVA	5
51 – VIA DELLE PANCHE/POGGETTO	5

IN THE SHORT TERM this study will need a follow-up regarding intersections and access to the existing urban bicycle network to clarify the causes and if there are infrastructural corrective actions to do to reduce the number of accidents and their seriousness; at the same time should be set up a suitable and inclusive information campaign for road users and cyclists.

IN THE MEDIUM TERM an interview will be carried on a meaningful sample of citizens to understand itineraries usually done and what kind of means of transport they use within the Municipality, so to obtain a wider and more reliable Destination Origin matrix. The methodology used for this kind of study will need to be made for global analysis including the whole mobility components.

At the end of all, infrastructural actions will be planned based on studies and preparatory analysis that will point out the primary actions to be realized for citizens security.