

DICAM

Department of Civil, Chemical,
Environmental, and Materials
Engineering



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

AUTC

Buildings and Sustainability
Division

Sustainable mobility transition in urban context: the ALMABIKE Project



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A conceptual frame: urban needs and transportation response

The world is inexorably becoming urban. By 2030 all developing regions, including Asia and Africa, will have more people living in urban than rural areas.

In the next 20 years, ***Homo sapiens***, “the wise human”, will become ***Homo sapiens urbanus*** in virtually all regions of the planet.

Cities, *whether large or small, city centers, suburban or peri-urban areas*, can be open or closed with regard to residents' ability to access, occupy and use urban space. The separation of uses and degrees of prosperity are so obvious that the rich live in well-serviced neighbourhoods, gated communities and well-built formal settlements, whereas the poor are confined to inner-city or peri-urban informal settlements and slums.

Separation between “Haves” and “Have nots” opens up a gap which can produce social instability or at least generate high social and economic costs not only for the urban poor, but for society at large.

In these terms during XX Century transportation systems are perceived as relevant driving force to economic and social development (**Gudmundsson et al., 2015**), but they are also followed by negative effect such as congestion, pollution, mortality in incidents and energetic resources consumption (**Moradi and Vagnoni, 2018**).

Sustainable transportation plays a relevant role in the transition processo towards Humanized and sustainable cities



Alma bike research activities overview and main frame

To reduce the *urban divide*, to promote a transition process towards sustainability, to improve environmental condition, to analyze variables acting on cyclists choices, the frame of the research has been based upon **the general study of adaptively and flexibility of transportation offer in terms of infrastructures, architecture services and safety, to respond to current Sustainable Transportation demand, with a specific focus on cycling**

Macro fields covered

Almabike interests different fields under a multidisciplinary approach.

- **On cycling**: to study the IOT role on cyclist behavior and choice of route;
- **On road safety**: to evaluate impact of road safety condition in urban and peri-urban area on cyclist routing
- **On road design**: to improve innovative design solutions (i.e.emergency dynamic cyclepath)



Alma bike: What is it?

Basically it's a connected urban bicycle, designed and copyrighted by University of Bologna, but it introduces a model of sustainable moving lab.

The bike features

- GPS tracker within the bike structures under seat with Anti-theft warning functions (**alert mail in case of unauthorized bike movements**)
- Smart sensor pack suitable for the seat with **detection function of PM2,5 – PM10, Noise, inertia parameters, environment parameters (humidity, pressure, Temperature)**

How the project works – the holistic approach

600 bikes available freely to students use (selected by a call) – Research issue: detection of behavioral factors (on routing, on safety, on road design)

50 bikes available freely for university staff with specific research purpose – Research issue:

- impact of IOT and cloud-sourcing approach on tripping,
- Impact of awareness of presence of air pollutants in the lanes on choice of route
- Monitoring pollution effectt on cyclists health

How does it takes to be realized

A long design journey from 2017 to 2020

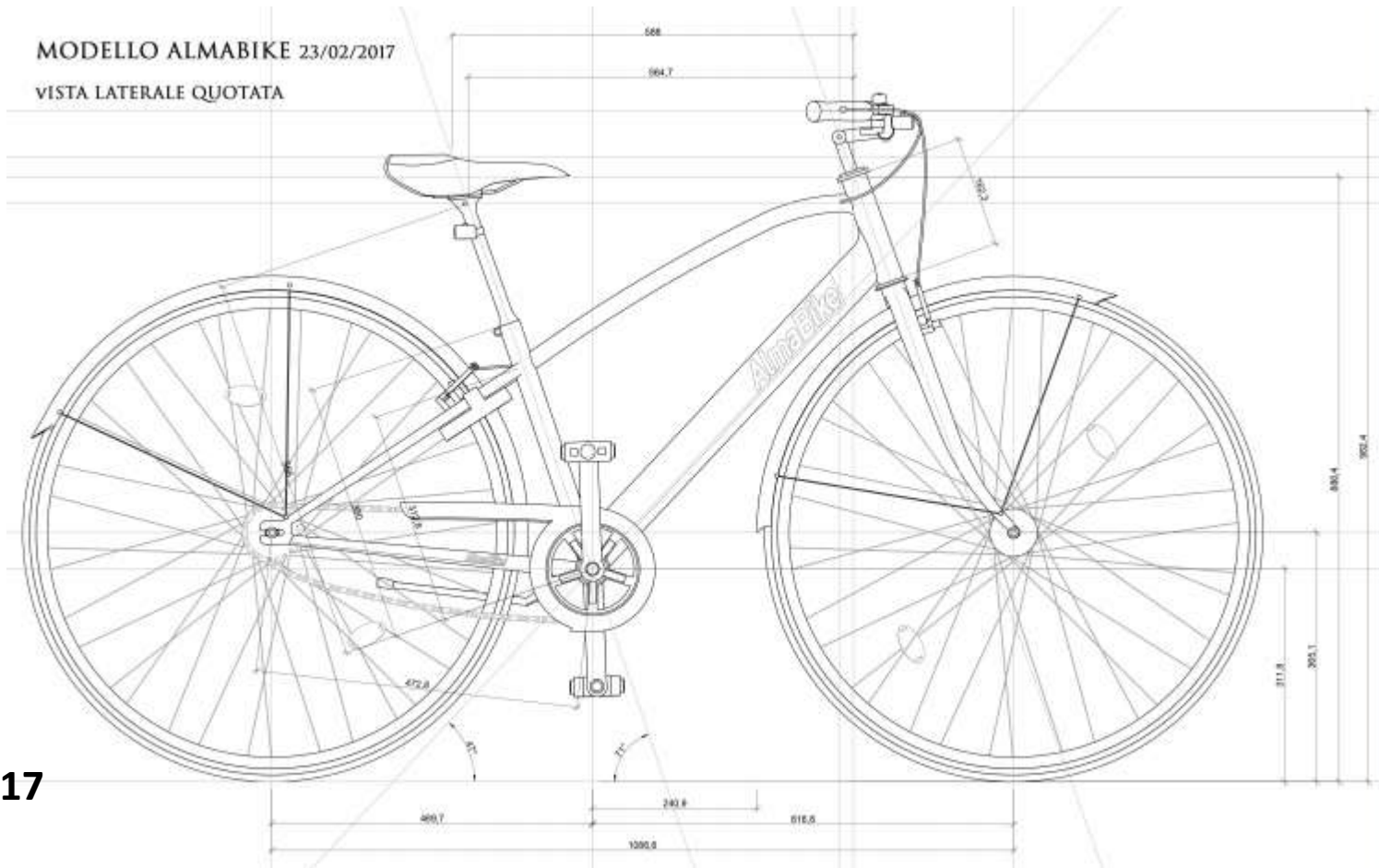


Alma bike: a brief history from 2017 to 2020

The initial visual concept of bicycles takes origin from a Design Call for student. The winner, an architecture student, defined this model, based upon an old traditional historical Bologna bike.

MODELLO ALMABIKE 23/02/2017

VISTA LATERALE QUOTATA



2017



Alma bike: a brief history from 2017 to 2020

The second step has been driven by a professional design (Jonny Mole), that realized the first prototype



2018



Alma bike: a brief history from 2017 to 2020

The final mode. Produced 650 in early 2020



2019 - 2020

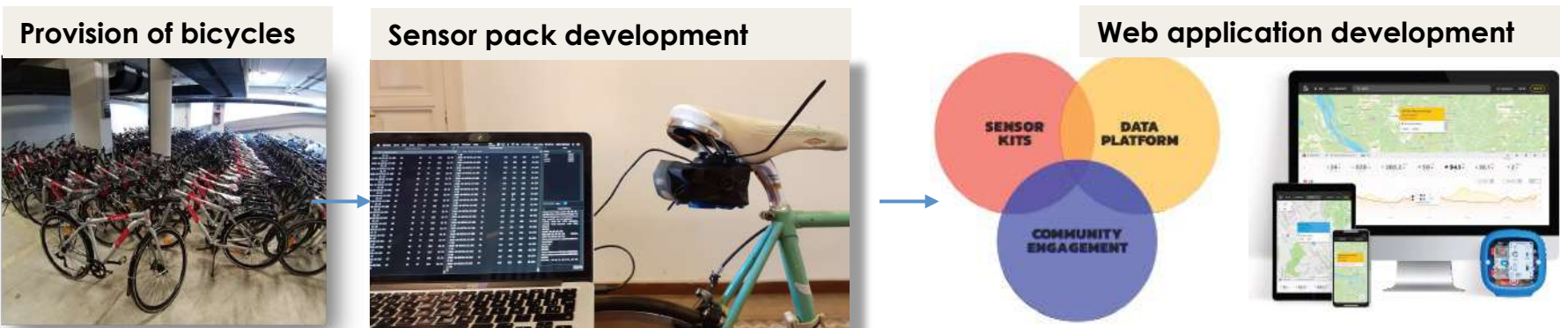


Main activities conducted in 2020

Smart sensor pack development in cooperation with
 Analysis of GPS *in-bike* location and transmission test.



Production of 650 GPS trackers, and web platforms development (Smartciziten and anti-theft warning system)



| | | |
|---------------------------------|-------------------|---------------------|
| Air Temperature | °C | Sensirion SHT31 |
| Relative Humidity | %rh | |
| Noise Level | dBA | Invensense ICS43432 |
| Barometric pressure | kPa | NXP MPL3115A2 |
| Equivalent Carbon Dioxide | ppm | AMS CCS811 |
| Volatile Organic Compounds | ppb | |
| Particulate Matter (PM1/2.5/10) | µg/m ³ | Plantower PMS5003 |

Research presented at
 and exposed at “Researcher
 Night 2020”

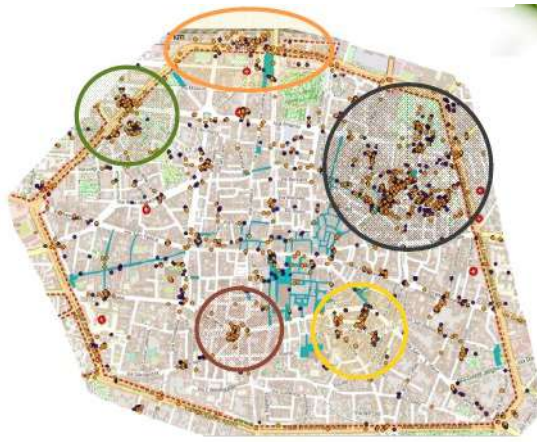


On cycling: a test / meta analysis

In parallel to **test** the potentiality of Almalbike research it has been used a cyclists tracking applied through the bicycles Challenge called **Academic Bicycle Challenge** (www.go-abc.org).



About 2.000 users registered that have registered their movements in the month of october 2019. Some interesting factors emerged on cyclist approach to road and existing cyclepaths



Research registered in Unibo Covid19 research database

| Name | Cyclaph type | Monthly Detected flow |
|-------------|----------------------|-----------------------|
| Via Irnerio | Absence of cyclepath | 23.384 |
| Via Marconi | Absence of cyclepath | 11.082 |



Alma bike: next level

The scientific level up frame is to study:

- **Effect on cyclists health of combination between PM2.5 and bioaerosol**, with specific regards of pollens (in cooperation with MD Hospital S.Orsola Bologna and BIGEA – Department of Biological, Geological and Environmental Science of University of Bologna)
- **Urban analysis on green area design to reduce allergenic exposures.**

Technology Innovation next step

Currently world wide it is produced only a type of digital Pollen Sensor. It's designed by Fuji Electrics and it is suitable only for Japanese cedar pollens.

The main concept is to develop an innovative model of micronized sensor pack able to detect grass pollens (more common in European context).

How it could works?

The main concept is to connect a smart spirometer to the cyclist smartphone and make a spirometric analysis before and after tripping.





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