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ABSTRACT

This academic paper speculates a near future scenario which relies on today's environmental, economic, sociological and political indications of EU and offers a future Mobility as a Service (MaaS) option for the city of Barcelona. The Urvan mobility service is a shared, connected IoT, electrical and autonomous mobility option for the Barcelona residents. The service has a connection with Barcelona's urban planning (Superilles) in a way that the mobility service works in parallel with how the city operates and how the city collects data. The aim of the service is to reduce the private ownership of vehicles within the city and consequently reduce the overall pollution imposed on the environment. Urvan is specifically designed to work with the Superblocks of Barcelona and can be scaled up to any city in the world. The service brings rich data collection, sharing and utilization models as well as new revenue models for mobility service providers. The paper explains how the future steps of implementation of the system can be done in any city and offers some already existing examples from different continents.

INTRODUCTION

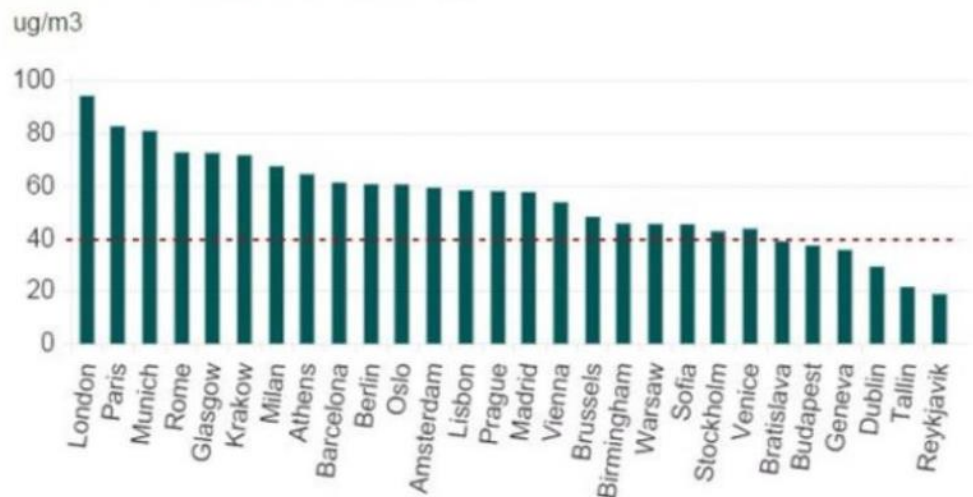
Research Question

This paper explores how the future of mobility would look like in the city of Barcelona in the future considering the technological, infrastructural and environmental changes. The paper will build upon a near future scenario based on today's signals of where Barcelona is headed in terms of mobility. The choice of Barcelona as a use case is made due to the fact that Barcelona has been the most high-tech and the smartest IoT city in the world. In 2010, Barcelona took the first steps to become the first smart IoT city in the world with the initiative of the city hall. The increasing need to go sustainable and environmentally friendly has ignited this initiative to make Barcelona a more livable and enjoyable city for its residents.

Background Setting

During the early 2000s, Barcelona has faced high levels of air and noise pollution. According to D'Antonio (2019), the bad air quality of Barcelona has affected and has been held responsible for 3500 premature deaths a year in 2004. The pollution was spread all over the city and there was no single quarter where it was possible to escape from it. Nino Kunzil, a research professor at the Municipal Institute of Medical Research and the Center for Research in Environmental Epidemiology, stated that Barcelona was racing up to be the 'worst in Europe' in terms of pollution. D'Antonio (2019) stated that Barcelona's Nitrogen Dioxide (NO₂) levels were above the 40 ug per cubic of the mandated EU allowance.

NO₂ levels in major cities in Europe*

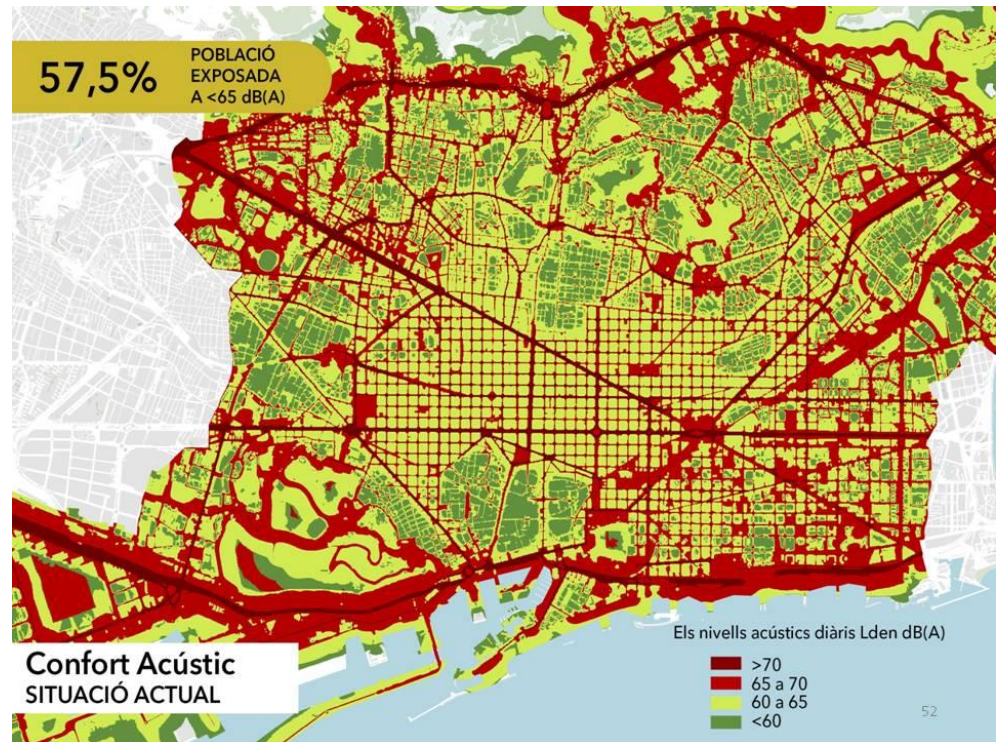


--- EU legal limit = 40ug/m³

*Highest readings across a number of measuring stations

Source: EEA

Noise pollution also generated problems within the city as it gradually made Barcelona as one of the noisiest cities in the world. According to Health Europa, more than half of the Barcelona residents was subjected to noise levels over 65 decibels for each day. At levels above 60 decibels of magnitude of noise pollution, an increase in cardiovascular disease and stress levels as well as hearing loss are present.



LITERATURE REVIEW

Future Infrastructural and Regulatory Changes of Barcelona

In 2011, The Smart City Expo and World Congress were held to ignite and launch smart city guidelines and policies for cities to become smarter, greener, and more sustainable for the first time. In 2010, Barcelona's vision and strategy to become a modern smart city had already begun by the City Council of Barcelona. According to Zigurat Global Institute of Technology (2019), Barcelona's definition of a smart city is formulated as: 'a self-sufficient city of productive neighborhoods at human speed, inside a hyper-connected zero emissions metropolitan area'.

According to MEDIUM magazine, the city introduced the term called superblocks and implemented smart sensors to the entire city. When looked at the city architectural plan, Barcelona resembles a connected grid on the map. According to Zigurat Global Institute of Technology, Barcelona is turned into an urban IoT hub where the city gathers, stores and transmits data among its parts. The software company Oracle describes IoT as 'The network of physical objects – things- that are embedded with sensors, software, and other

technologies for the purpose of connecting and exchanging data with other devices and systems over the internet'. In 2012, responsive technologies across urban systems that were deployed to transform Barcelona to a smart city included public transit, parking, street lighting, waste management, city bike system, noise sensors, and irrigation system. According to Adler (2016) from Harvard, when Barcelona launched the IoT programme, they already had a decent infrastructure which consisted of 500 kilometers of fiber optic cable spanning within the city for connectivity.

The fiber technology infrastructure was created 30 years ago and now serves as the backbone for smart integrated city systems. The high connectivity network has the purpose of serving as a direct link to the internet for the people of Barcelona. The WiFi IoT system enabled the city to improve and optimize energy efficiency by implementing smart meters which monitor energy consumption within the city.

According to Adler (2016), in waste management, the residents throw waste in smart municipal bins that monitor waste levels and optimize waste collection routes. The implemented sensors also have the possibility to promote environmental security as well as sustainability by sensing the hazardous waste materials and locating them digitally on the map.

In transportation, Barcelona has adapted a diverse strategy meaning that the city has promoted using electric cars and bike sharing at the same time invested massively in improving the bus and parking systems. The city has transformed its bus stops into digital bus stops for the residents to have an interactive experience with digital updates on bus locations, free WiFi and charging slots.

For riders, the city designed apps for experiencing the city in a more pleasant way. For drivers, a smart parking system which directs them to available parking slots. This smart system of parking is enabled by sensors which are embedded beneath the asphalt. The sensors sense whether a vehicle is parked in a specific spot or not. The aim of the parking system was to reduce the traffic jam and consequently the overall emissions.

Barcelona, for the city lighting plan, utilizes smart lampposts to improve efficiency and environmental sustainability. Smart lampposts sense city residents who are in near proximity and light up; on the contrary, when there are not any residents in the close proximity, then the lights automatically dim to conserve energy and promote environmental conservatism. The lampposts are also utilized as direct WiFi spots for the residents throughout the city for a

seamless digital experience. The sensors which measure proximity also collect data on air quality and transfer raw data to city officials. According to Harvard University, the implementation of smart lighting plan made a total output of %30 reduction in the energy costs.

One of Barcelona's districts, Plaza del Sol, known for its nightlife and vibrant young culture, has implemented noise sensors around the piazza for measuring overall noise levels. Residents of Piazza del Sol have been living under unbearable noise levels since the early 2000s. Barcelona has found an easy and low-cost way of detecting noise-levels, pollution, and temperature. The sensors enabled the residents to measure and detect noise levels that were above the 100 decibels threshold which WHO proved to be unhealthy.

According to Adler (2016), in her article named 'How Smart City Barcelona Brought the Internet of Things to Life, stated that public areas which are for leisure activities like parks were also implemented with IoT technologies to measure and collect data on water levels and irrigation. The sensors were also used to gather data on collecting rain, humidity and temperature data so that the public workers who work at parks can estimate and determine how much irrigation is needed in a specific area. This IoT system then enables remotely controlled water deliveries across the city with electro valves. The system made an impact of %25 in water conservation and 555,000 dollars' worth of public savings despite the fact that the diffusion of the system has only been up to 68% of public parks.

The smart sensor systems that are implemented throughout the city compose a smart sensor network which generates and collects data that can be utilized by the city authorities to make enhancements and improve the life of the residents as well as to better optimize city services to promote cost and environmental sustainability. According to MEDIUM, the city of Barcelona has estimated that the implementation of the smart IoT sensor systems made a total saving of 58 million dollars' worth of water consumption and increased public parks' revenues by 50 million dollars annually. Smart lampposts made an additional 37 million dollars' worth of savings annually. 47.000 new jobs were created and overall usage of water and valuable energy is decreased.

By implementing IoT technologies throughout the urban spaces, Barcelona has attained high levels of environmental sustainability and public economic savings. The effects of Iotization of the city reduced traffic and lowered emissions,

created savings on water and energy and promoted overall quality of life for Barcelona's residents.

The reasons for Superblock implementation within the city of Barcelona are due to increased environmental concerns and a considerable decrease in livability standards. The plan is to give the city back to the residents by opening the areas which are occupied by cars and transportation. The city plans to increase sociability among its residents by providing them the necessary urban spaces in where they live. Increasing usage of private vehicles and an urgent need to switch to a social economy which is more sustainable both environmentally and economically was the foundation of this act.

City Mobility Options of Barcelona

Barcelona, home to 1.5 million residents, provides various transportation options for its residents to roam freely and easily in order to attain safe, sustainable, equitable and efficient levels of mobility. The diverse options include public transport, electric city kick scooters, electric scooters, public & private bike sharing and car sharing. One of the reasons why Barcelona has such diverse options is due to its booming start-up ecosystem.

Electric kick scooter sharing options include Reby and GOMEEP. Reby, is a local Barcelona startup that offers on-demand kick scooters. Just like the sharing giant Lime, the kick scooters are scattered across the city and the residents can unlock the service by using their account on their smartphones. The service offers no dedicated mandatory parking spot for each scooter and unlocking can be done anytime during the day. The payment is a pay-as-you-go method and 1 euro is the unlocking price with a 0.15 euro per minute charge. GOMEEP however, is a kick scooter service that is not for sharing but for renting. It is an option for people whom would like to use kick scooters regularly rather than occasionally. The door-delivery is taken care of GOMEEP within the first 48 hrs of purchase. Repairs and replacements are also included to the subscription plan of 39 euro a month.

Bike sharing is another mobility option for the Barcelona residents to move around freely within the city. Bicing is the local authorities' bike sharing service which contains regular bikes with electric bikes as options. The subscription model is a one-time fee of 35-50 euro annually and a small fee for 30 minutes as you ride. The bikes can be found in their designated parking spaces. Donkey

Republic is another bike sharing option similar to Bicing which offers pay-as-you-ride option for the residents.

Electric scooter sharing offers the most variety for the residents. YEGO is a startup that offers Barcelona residents the option to travel within the city with a vespa-like scooter. YEGO is one of the best in the market with great usability and freedom to park anywhere within city limits. The usage charge is 0.25 euro per minute with a subscription fee. eCooltra is the biggest local electric scooter sharing service. Just like YEGO, eCooltra costs 0.26 euro per minute with a subscription fee. Scoot is the stylish retro electric scooter sharing version of Barcelona having a range between 0.15-0.28 euro per minute usage charge. Acciona is the newest sharing service with similar offerings and charges.

Carsharing, ridesharing or car rentals are another option of moving around in Barcelona. There are 2 types of carsharing, electric and petrol based. Barcelona is one of the first cities in Spain where you can rent electric cars. They also have various changing points which make users never run out of battery when they roam around the city. The difference between electric car sharing and electric car rental is that renting requires a specific time of pick up and a date to return. It is a limited electric vehicle usage method; whereas, electric car sharing is a pay-as-you-go method which does not require any booking in advance. Car sharing is a more flexible way of moving around which enables spontaneous trips with lower costs. Ubeqoo is a subsidiary of Europcar which offers car sharing to residents. Just like any other sharing company, it is a pay-as-you-go. SocialCar is a local Barcelona-based peer-to-peer car rental service which allows renting cars from individuals who made their cars available. You can book cars which are owned by others and arrange pick-ups and drop-offs. Getaround is a similar service like SocialCar where individuals rent cars to each other. Amovens is platform which offers all three-in-one containing renting, peer-to-peer sharing and ride sharing options. It also allows car lenders to drive people around for a price.

Superblocks of Barcelona

The Superblocks (Superilles in Catalan) are different apartment blocks which are combined together to create a traffic-calmed area. Barcelona was completely designed from the start into a very firm grid modernist planning layout by Ildefons Cerda in the 1850s. According to Gupta (2019), Cerda's Barcelona

vision was the most famous large scale modern urban plan and is cited as a model for modern mixed-use neighbourhoods.

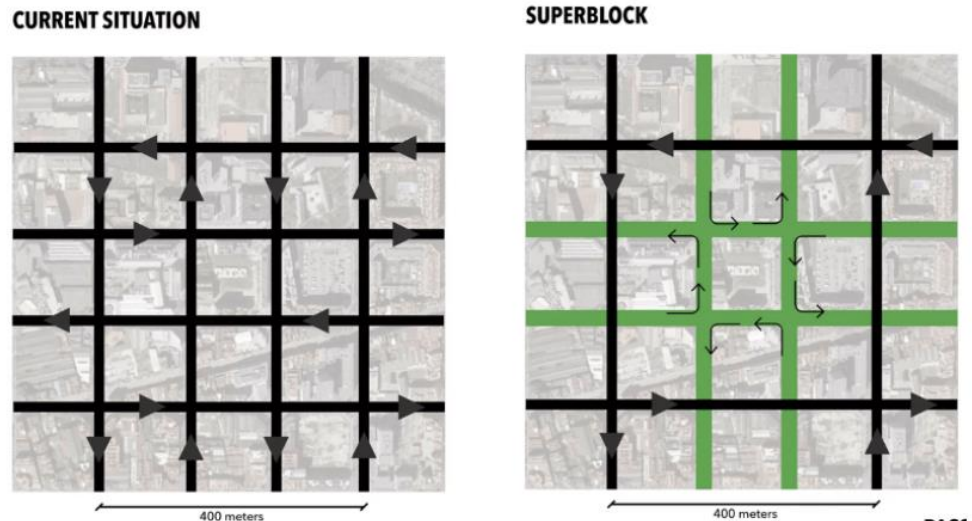
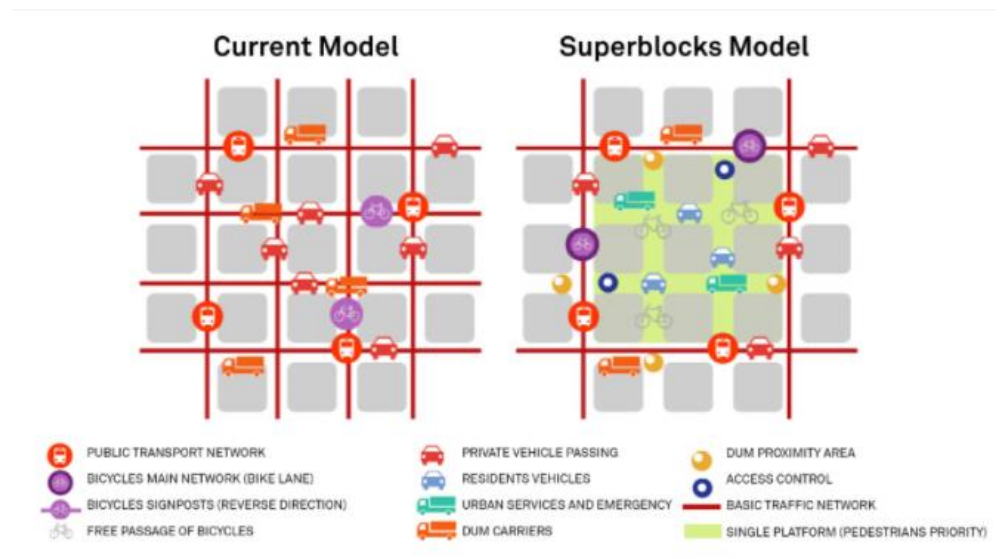
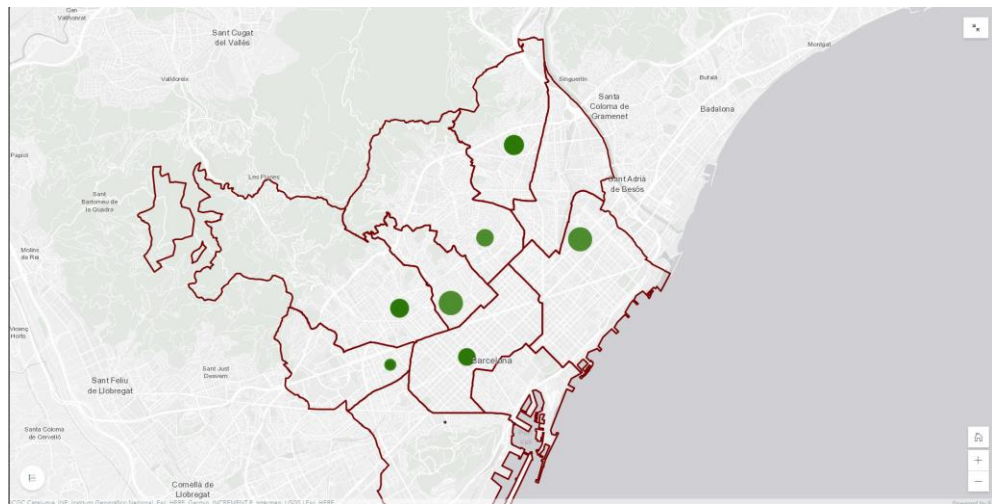


Figure 1: Superblock Plan, Credit: Vox.com



The Superblocks are located in the Sant Marti district of Barcelona which is also known as the Poblenau neighbourhood of Barcelona. The director of Urban Ecology of Barcelona stated the characteristics of Superilles as ' Every Superblock is like a small city with its own character'. The action plan contained two major steps, the first step made initial changes by prohibiting the speed limit to 12 km/h, the second step involved the limit to be decreased to 10 km/h and eliminated the roadside parking. According to Vance (2016), in addition to the reduced speed, motorists will only have the option to do a loop of only turning left that will eventually put them out of the superblock which allows

people to use the interior streets for sports, activities, games and outdoor events. The Poblenau Superblock is consisted of 9 city blocks of about 400x400 meters with a total of 13,350 square meters restored for pedestrian use. According to the Centre of Contemporary Culture of Barcelona (2018), the implementation of Superblocks in the Poblenau has dropped the total vehicle usage within the inner streets by %58.



Within these Superblocks, only residents and delivery traffic are allowed to drive on the connected streets at a walking speed. The blocks were designed as low rise buildings with pedestrian walks and tree-lined boulevards. The 45-degree angles of the blocks allow more sunlight and better airflow through the interior atrium. The aim is to create 'shared community' living spaces within the apartment blocks to foster much more liveable streets where the pedestrians' wellbeing will have the priority and more important of all, a new way of shared community is created among the residents of the Superblocks. Currently, there are 5 Superblocks implemented within the city, but the aim is to have as many as 500.

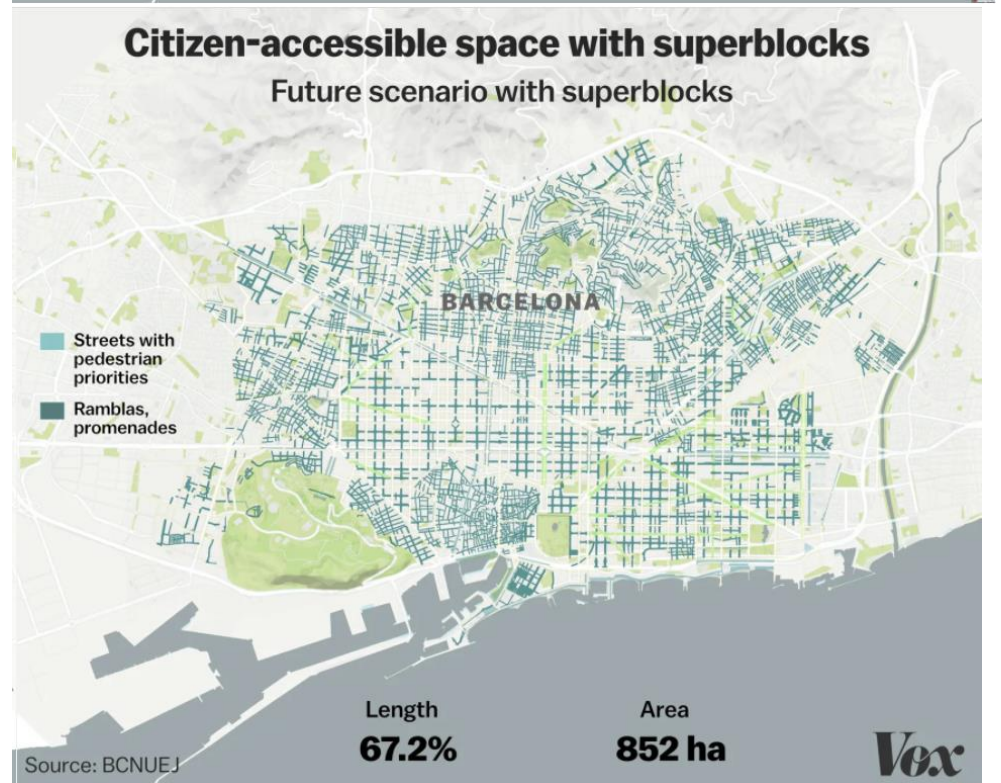
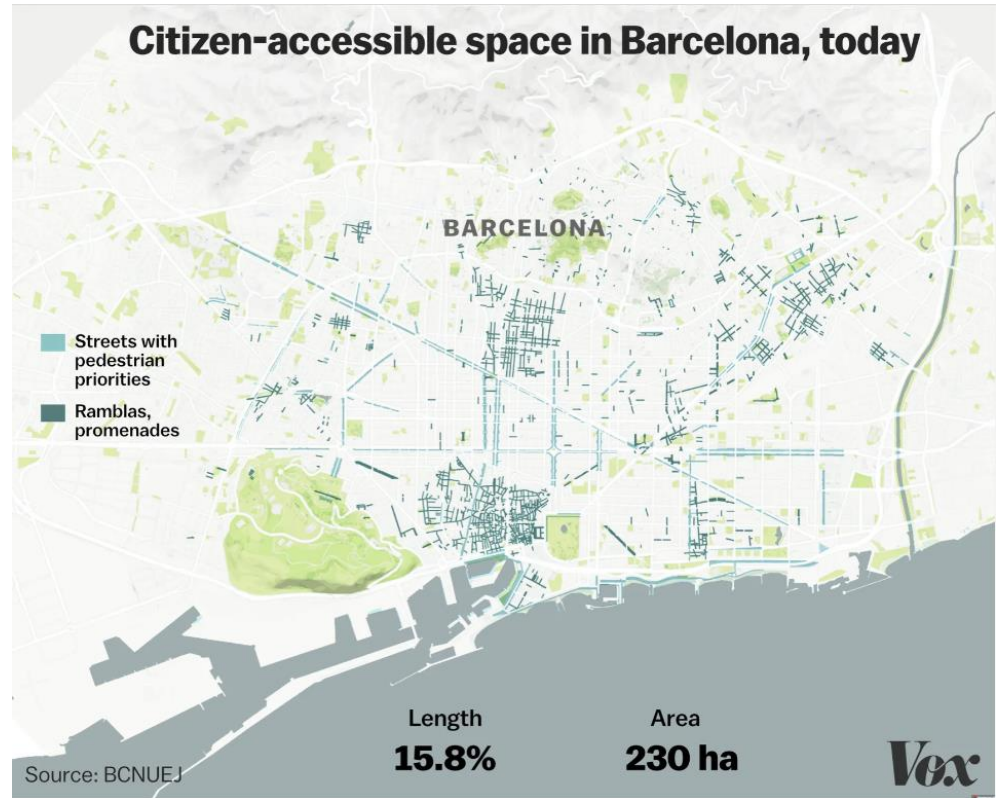


Figure 5: Barcelona is uniquely positioned for Superblocks, with an already grid based street system, Credit: Vox

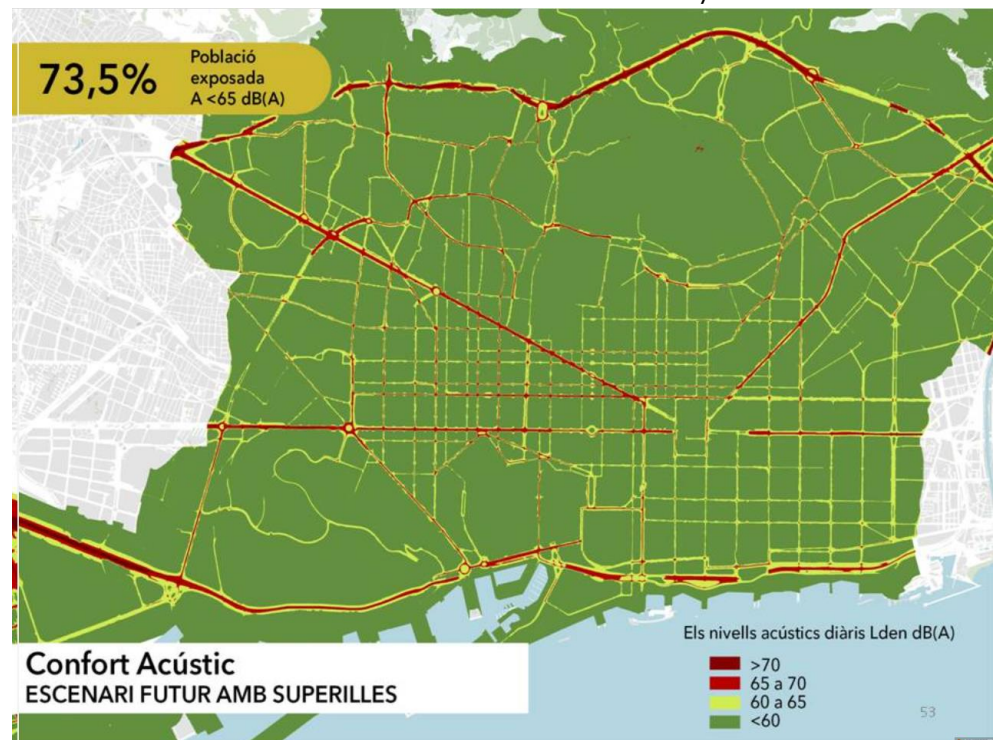
The Superblocks are implemented because of increased congestion, reduced green public spaces, increased parking difficulties, sky-rocketed air pollution and gentrification. Salvador Rueda, Urban Ecology Agency of Barcelona's director, had the Superblock vision to increase public spaces by reducing cars within the city to promote shared living among neighbourhoods. According to Gupta (2019), in 2014, due to an increase in real estate, lower income residents were forced to move out from the city centre towards the suburbs creating a higher need for private vehicle usage and increased traffic, air and noise pollution and insufficient downtown parking spaces. In order to solve the parking problem, most of the city centre green areas were converted into public parking areas which killed the city atmosphere. The main focus of Superblocks is to eliminate cars within the city which accounts for up to %70 of city's public available spaces and give back the streets to the pedestrians.

The designed superblocks were not just intended for only environmental protection and greener world but also, they were designed to serve as a great socializing and commercial factor. In a study conducted by Roberts (2019), it is stated that in the Garcia district, the foot traffic has increased by %10 and bicycle usage has increased by %30. This creates the possibility to have social interactions within the community. According to D'Antonio (2019), a clear example of fostered social interaction has been found in San Antoni Market superblock which is in the Eixample district. Augusti Colom, the head of commerce on Barcelona's city council has said that the market generated business and it is a point of attraction as well as being a social nexus. If the

superblock plan is to be implemented fully, then, there would be %300 more area accessible to the pedestrians which will give the city back to the residents.



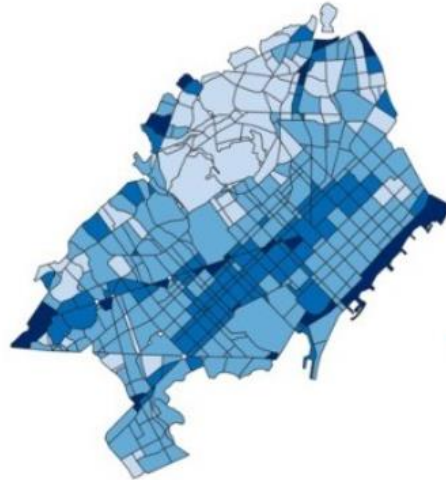
Drastic noise reduction is also attained due to the establishment of Superblocks. According to Ajuntament de Barcelona (2019), within the Poblenou area, the overall noise pollution had a daily reduction of 5 decibels due to reduced usage of cars. If the 500 Superblocks plan were to be implemented, %73.5 of Barcelona's inhabitants could live under 65 decibels a day.



Barcelona became breathable after the implementation and the overall quality of the air increase drastically. When Superblocks were introduced and the numbers of the Superblocks were increased, the number of daily personal vehicle usage has dropped. According to Environment International, public transportation usage has increased and almost 228.000 trips have been shifted to public transport. This transportation change led to a 25% decrease in Nitrogen dioxide emissions which provided a cleaner and fresher air. This reduction in the overall, decreases 291 deaths annually which are caused by nitrogen dioxide emissions. Now in Barcelona, there is not a spot with an nitrogen dioxide emissions level above 60 micro grams. In the World Air Quality Index located in Beijing China, Barcelona has an index rating of 26 out of 500 which compared to Paris 115 and London 97 seems to be a successful implementation.

NO₂ (µg/ m³)

A



B

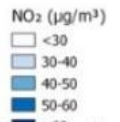
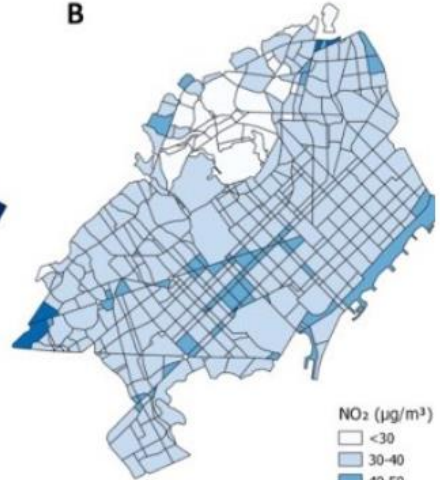
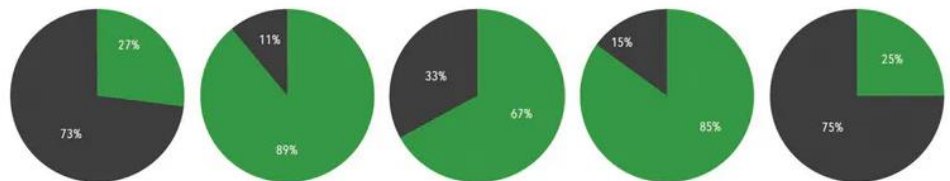
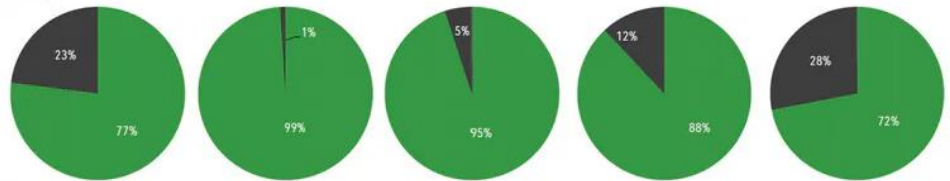


Figure 8: Difference in Nitrogen Dioxide Emission in Barcelona Before and After Superblocks, Credit: Environmental International

Current situation



Superblocks model



Space for pedestrians (versus road)



Accessibility (sidewalks >2,5m)



Air quality (immission <40µg/m3 any)



Acoustic comfort (Ld <65dB(A))



Liveability index in public space



Sociological and Economic Changes and Trends in the World

The economies of today are substantially changing and expanding due to newly emerging markets, new technologies, social and environmental policies, and volatile consumer behaviours. For the past 50 years, rapid growth in

digitization, innovative business models and high automation gave tremendous opportunity in transforming markets and especially the greater mobility industry. Mobility has developed rapidly in the past decade due to disruptive technologies as electrification (EV), autonomous driving (AV), cloud connectivity (OTA) and mixed mobility service options. Gao, Kaas, Mohr, Wee and Möller (2016) have noted in their article that the upcoming disruption is already at the door and there is still no clear horizon on how the mobility service industry will be in 10 to 15 years.

The main arena where disruptive technology trends and business models compete to grasp a fair share for the service market from the traditional OEMs is the 'Urban Mobility Space'. The urban mobility space is hosting the emergence of fresh actors, newly established partnerships and innovative services that bring value to the residents. The industry exhibits now various startups and newly established young companies which are related to the new trend/concept of Mobility as a Service (MaaS). According to Oksana (2019), Mobility as a Service is a new ground-breaking concept that is consisted of: alternative (autonomous) driving, electric vehicles, and on-demand services. The service model is a network of mixed coordinated transportation forms which can be integrated at various moments of the commute journey in the most effective and cost/time/comfort optimized way.

The present day vehicle/automotive-centric view which heavily relies on ownership is going to be replaced with a more efficient and sustainable (both cost and environmental) customer-centric one. The opportunity to plan and book diverse transportation services from an app which includes electric and autonomous vehicles, electric bikes and scooters or green public transportation methods in various parts of the journey will be very soon on our doors. The future of mobility and the urban mobility space cannot be thought without considering the general policies and the future city planning. Today's socio-economic reality is rapid urbanization, steady population growth and environmental concerns which push growth in new mobility forms to keep social factors stable and satisfied.

The policies that aim to address these socio-economic realities also contain environmental restrictions in terms of consumption ceiling or taxes to be paid to the state to reduce and control the negative environmental trends. The next generation mobility should be in accordance with all the general and especially the local policies to be present. According to the article 'Disruptive trends that

will transform the auto industry' by McKinsey (2016), states that city type will replace country or region as the most relevant policy and consumer behaviour dimension that determines the speed and scope of the industry with regards to the future of mobility. Grasping where the industry is headed requires a more scoped view in segmenting every city in terms of consumer preferences, digital nativeness, regulation and policy, accessibility, and willingness to pay. Gao, Kaas, Mohr and Wee (2016) argue that once technological and regulatory issues have been resolved, at least %15 of the new cars sold in 2030 will be fully autonomous electrical vehicles.

The adoption of electrified and autonomous vehicles will be determined by the city residents' willingness to switch and regulatory barriers that are imposed by the city planning authorities. Adoption rates will be higher in cities which strict carbon emission taxes and regulations occur and which already have built the necessary technological infrastructure. What can easily be observed is that the future of mobility will be much more digitized, safe, convenient, accessible, and economically affordable. There is a considerable divergence in the factors that constitute a city and make it different from one another; therefore, the type of the city will then become the key indicator for future mobility services.

INTERVIEW OUTCOME

Interview Synthesis

There were 2 interviews conducted on former residents of Barcelona on the overall mobility understanding and the Superblock system of the city. The main highlights that came out from the interviews were that since 2005 and onwards, Barcelona had an increasing level of overall pollution and high levels of traffic congestion due to high concentrated population within the city and high numbers of private ownership of vehicles. The city had long travel times with public transportation and the main reason why the city had higher levels of private ownership of cars is due to long commute times. This came out to be a key insight of the interview since it was a 'vicious cycle' meaning that the reason for higher levels of congestion and pollution is high numbers of private vehicle ownership but the only alternative which can reduce this actually causes increase in private ownership. The higher in-city commute times the higher private vehicle ownership. On the other hand, the implemented urban planning of Superblocks within the city made Barcelona a more liveable city. It reduced overall vehicle traverse within neighbourhoods thus gave more city space for the

residents to enjoy and have spend time. Even though the benefits of Superblocks outweigh the negative factors of the Superilles urban planning scheme, one prominent negative factor came up during the interview. The Superblock system caused 'gentrification' within the city which is caused by increased rent due to higher and better standards of the Superblocks. This pushed people with lower income towards the outskirts of the city and since the in-city commute times were very high, the overall liveability of the city was very low. In conclusion, before the introduction of Superblock system within the city, Barcelona had significant levels of overall pollution and inordinate amounts of congestion and commute time.

Read the Annex slot for full interview documentation.

PROPOSED SERVICE DESIGN - URVAN

Future Mobility Service of Barcelona – Urvan

Urvan is a shared mobility service which is designed specifically for Barcelona Superblocks to enrich the co-living experience. It is a service dedicated to the residents of Superblocks to have their own shared mobility fleet at their service as a subscription base model. The Urvans are electrical autonomous urban vehicles that work as private chauffeurs for the entire single superblock either for personal or more than one person usage. During the day the residents of the superblock through an app designate their daily commute routes on the system and the system generates the most optimal route batches for the Urvans to follow and transport the residents all around the city of Barcelona. Every resident will have a skeletal commute routine calendar and these routines will be put together for a shared commute route. The electrical vans will then calculate the necessary commute paths and destinations for optimal transportation paths. During the day when the residents are at work and none of the residents needs to use the mobility service, then, until the needed time, the electrical vans will be infused to the greater Barcelona mobility for other residents to use until they are needed by their original superblock residents. This way the usage of the privately owned vehicles will decrease and the load of the urban mobility will be moved from ownership to shared.

The Urvans greet you the moment you enter the vehicle and display all the relevant information to you and activate all the previously booked infotainment system. The optimal route is already calculated from the information the user provides on his/her calendar which is hooked up to the Urvan cloud. If there to be route changes, additional stops or destination changes along the way, the

Urvan automatically re-routes the most optimal path. When a route change happens, passengers inside the Urvans can benefit from the journey by utilizing the various digital applications that the Urvans offer. The digital applications are connected to the overall Urvan infotainment cloud where all the user preferences are stored. For instance, if you are sharing the Urvan with a family and the members of the family preselected a Netflix cinema subscription and a digital work environment, then the family can benefit from these digital applications along the journey on the Urvans' big digital screens.

System & Technology Description

The service will be driverless, electrical, autonomous, connected and shared. It will be a 'Superblock IOT fleet' mobility example where the mobility service is connected to the overall Barcelona city as well as to the specific superblock that it belongs to. When compared to the regular combustion engine transportation options, Urvan is more environmentally friendly, efficient, safer, comfortable, and cheaper. The ability to be connected with its' surroundings enables the mobility service to gather data and provide user(resident) feedback to the municipalities for further city upgrades, for example, if one specific route is being overcrowded and expected to be even more overcrowded in the future due to predefined skeletal commute routes, then the municipality can act accordingly to prevent congestion and increase resident happiness by providing less traffic time. If one area of the city has increased noise and air pollution then the Urvans can re-route themselves to avoid that area to decrease pollution and notify the residents about the situation.

The Urvan service, due to its connected nature to the city techno-infrastructure, the vehicles gather various data throughout the daily commutes. The collected data is consisted of location of rough roads, congestion points, limit exceeding air and noise pollution locations and consumer data which can further give possibility to do geo-marketing. The city of Barcelona can exploit these collected data in accompany with the other embedded sensor data scattered around the city for increasing resident satisfaction and overall city wellbeing. The nature of moving vans brings real-time reliable data and with these data, the rough roads can easily be located, air and noise pollution can easily be acted upon and various local commercial marketing opportunities can be created. The service will then operate as a multi-sided platform where the users and mobility vans become the source of data gathering whereas the city of Barcelona and local commercial businesses become the buyers of data. The residents' collected

behaviour data will then be used for further future investment analysis to make the city a better and a more liveable environment.

Data Utilization & Geo-Targeted Marketing Opportunities

Urvan service also brings rich marketing opportunities such as geo-targeted marketing for private brands. The exterior chassis of the Urvans work as a communication layer between the neighbourhoods and the advertising brands. Street-level digital media is communicated to the hyper-targeted residents at the relevant moment. Some of these information could be from the municipality as simple as location, time, weather, live events, new products or even future roadwork announcements. A customizable and a scalable campaign hinge on viewer/resident profile. The displayed ad or campaign changes from superblock to superblock since the residents' profiles change as well. If the Urvans are travelling through a fashion district then the advertisements will display the fashion brands' advertisement campaigns or event updates such as sales or product launches. Digital services lift the burden of finding a parking space there will be no need for parking, but if there is a need for short parking, the Urvans can be used as urban advertisement billboards that interact with their environment.

Personalized & Enjoyable Commute

Urvan system aims to propose a hyper-personalized connected mobility in a sense that the unlimited mobility options create a whole new spectrum of transportation possibilities that beyond than going from A to B. Urvan offers a new possibility for the users to have more quality time available for the things that are crucial and important in their lives. Interactive screens, display screens, digital presentation boards and small eating units are some examples of what the Urvan system offers for the future of mobility of Barcelona residents. The digitized Urvan interior offers a wide range of configuration options which enable high personalization for the users. Personalizing your commute means that if you want to listen to a specific music at a specific moment of your journey then all the user must do is to plan it through the app. The Urvan adapts itself to the user and learns from specific behaviours that can be repeated and offers it as an option for the next trip.

Specificity of Urvan

Urvan service sets itself apart from services like Uber, Lyft, Curb or Gett by combining IoT autonomous driving, electrical motor, digital entertainment

options, shared mobility, 3rd party marketing options and adaptive routing in one service which works in parallel with urban systems or plans like Barcelona Superblocks. What makes Urvan unique is the compositional factors that come together. Urvan is not a service which acts as an alternative mobility option for taxis or other public transportation means but rather it is a service which aims to replace private ownership of vehicles and preserve the city environment in the direction of EU environmental standards. It is a service which embeds IoT technology with sensors which collect information on pollution, congestion and road information which then can be utilized for better public services. The system collects real-time trackable data on the city with its in-built vehicle sensors and adapts routes accordingly. The Urvan system is also digitally connected with the city infrastructure and when there are to be changes on individual mobility routes, the Urvan system pulls traffic information from the city and calculates the most efficient path. Another specificity of Urvan system is the ability to use idle cars at night as delivery trucks. The idle vehicles without any prior booking can be rented and utilized by delivery companies for in-city deliveries.

Booking & Rezerving Urvans

Booking of the vehicles is done through the Urvan app that can easily be downloaded through any Appstore. Urvans can be booked at any time without prior preparation or reservation. The user must create his/her own profile in the app by giving his/her entertainment or work preferences and purchase the service subscriptions that he/she would like to have in the Urvan. Whenever a booking is made on any Urvan, the user profile is then uploaded to the booked Urvan for user customization. In this way, dependency on one of the Urvans will be eliminated and any Urvan on the street becomes everyone's Urvan at the end of the day. Ownership of mobility vehicles becomes not existent since every resident owns neither but has access to all. This subscription model eliminates the additional environmental and economic burden of owning a combustion engine vehicle.

Revenue Model

The service revenue model comes from the user subscriptions, sales of data to third parties and commercial business advertisements. The multi-sided platform enables revenue generation from multiple parties. The majority of the revenue comes from the user subscriptions and in-vehicle digital service purchases through the app. Even though the digital services provided through the app do

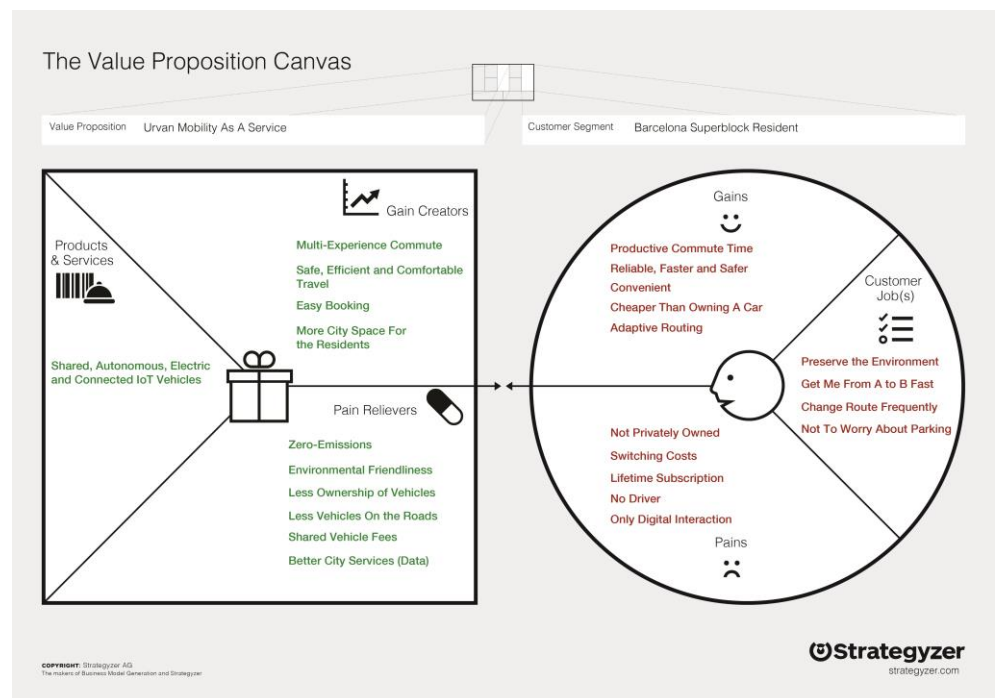
not belong to the Urvan ecosystem, there is a mark-up on every purchased digital service through the app since the customers primarily reach third party services through the Urvan ecosystem. The city data which is acquired through mobile Urvans during the day can be purchased by municipalities or commercial businesses for further future consumer data forecast. The municipality can detect any damage on the streets without having to employ teams that do on-site checks. This way the touring and spotting will be done by the Urvans and fixing will be done by the municipality. The commercial businesses benefit from mobile digital advertising billboards which are 24/7 on the streets and commute every street of Barcelona. Commercial business can purchase digital advertisement space on the Urvans and promote their businesses' sales, promotions or new product launches real time to the residents. They can also provide direct links to their businesses on the app for further information.

VALUE OF URVAN SERVICE

Value Proposition

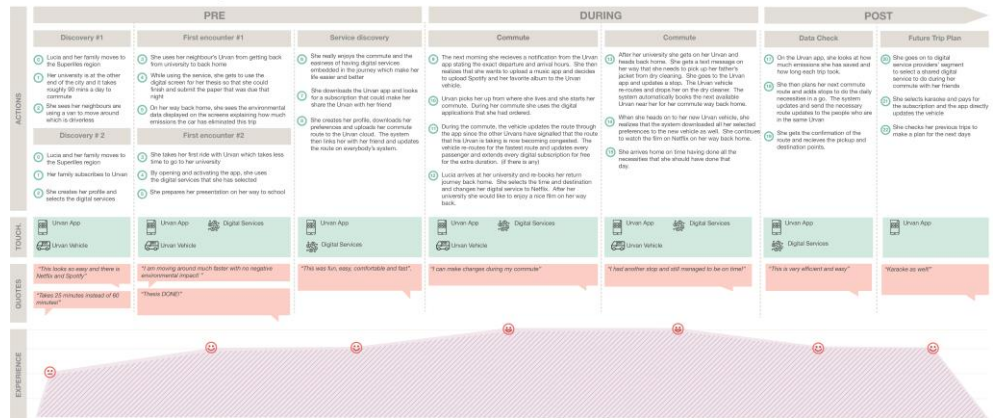
Urvan offers a multi-experience transportation opportunity for the Barcelona residents with comfortable, safe and efficient urban vehicles. Efficiency of the service comes from the self-adapting routing system for the least commute time and non-combustion electrical motors which are autonomous. Environmental friendliness is the main reason Urvan as a system is suitable for the Barcelona Superblocks. The future EU environmental restrictions will force the local municipalities to restrict the private ownership of vehicles due to carbon emission limitations. The value of Urvan is distributed on 5 levels. The first level is the value for the user, the second layer is the value for the city, the third layer is the value for commercial businesses, the fourth layer is the value for the environment and the last layer is the value for the third party digital service providers. The value for the user is the easy, comfortable, fun and multi-functional travel option. The ability to book easily through an app gives great benefits in planning the journey. The shared mobility model also has monetary benefits for the users since the shared vehicle will still have the same digital amenities but with a lower price. The value for the city is that there will be less vehicles on the streets and more space for the residents to enjoy the city. There will be higher strategic levers to stay below the EU restrictions and higher possibility to regulate the mobility standards. The data provided by the Urvans to the municipality will strengthen the bond between the city hall and the

residents since the data gathered from the urvans will be used to fix and make better the city services. The Barcelona city can now employ fewer workers to detect the broken roads or fix the disordered city lamps. Commercial businesses benefit from the ability to market themselves and their products on a mobile billboard. The ability to market themselves depending on the location gives them the value to directly target their segmented users. There will be a direct opportunity to bring their brand to where their users live or work faster and in a more interesting way than just a city billboard. The value for the environment surpasses any other value that the Urvan service creates. It drastically lowers the private ownership of combustion engine vehicles and provides a cleaner mode of city transportation to the city of Barcelona. Urvan secures the longevity of clean environment of Barcelona and helps the city to maintain its current environmental status. Cleaner air, less noise pollution and more space for the residents to enjoy the city are the major values that Urvan service creates for the environment. The value for the third party digital service providers is that the service providers will have a new domain to provide their digital applications. Different digital services can be created specifically for transportation and can be made purchasable. The digital applications can be marketed through the Urvan app so that the service providers can reach different segment of customers. They can enlarge their customer base and enrich their service offerings to satisfy various needs.



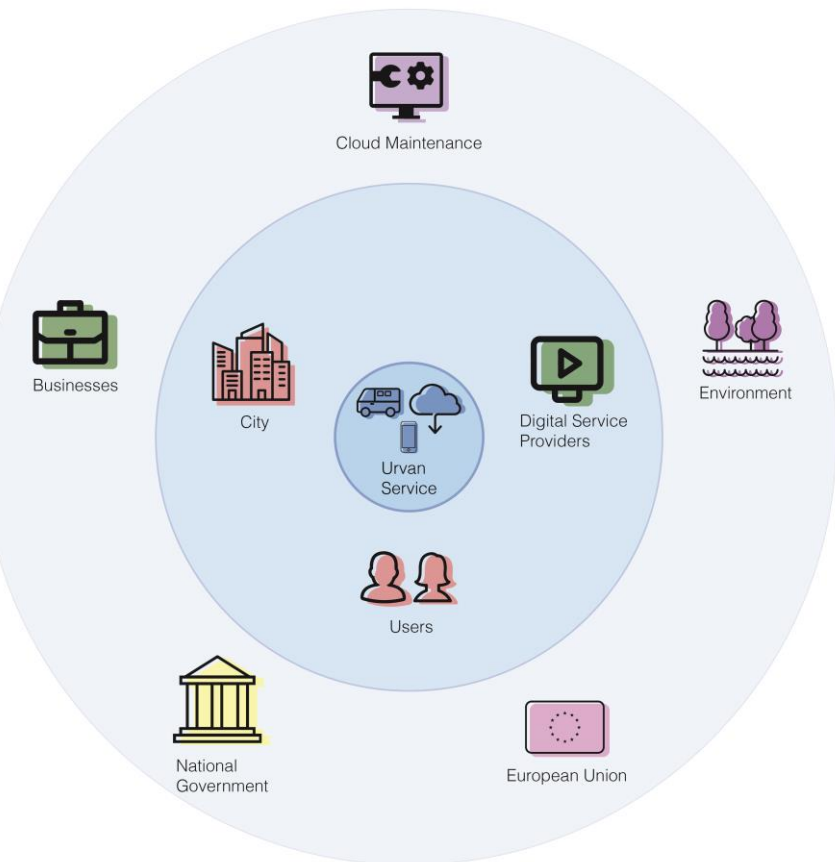
Urvan: The Future Mobility of Barcelona

Urvan User Journey



Stakeholders Map

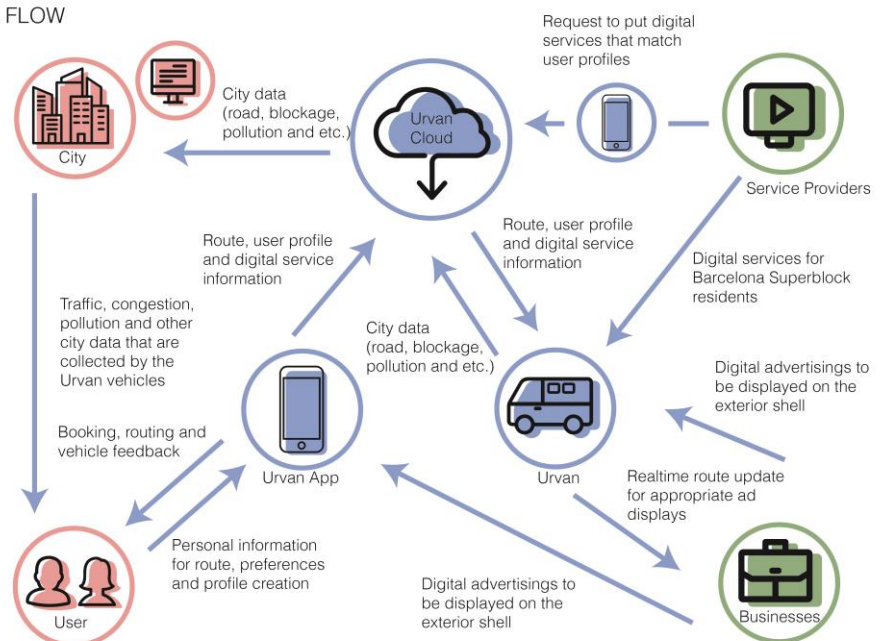
The main stakeholders that interact and form the service are the Barcelona residents, Urvan vehicle and service providers, Urvan cloud maintenance



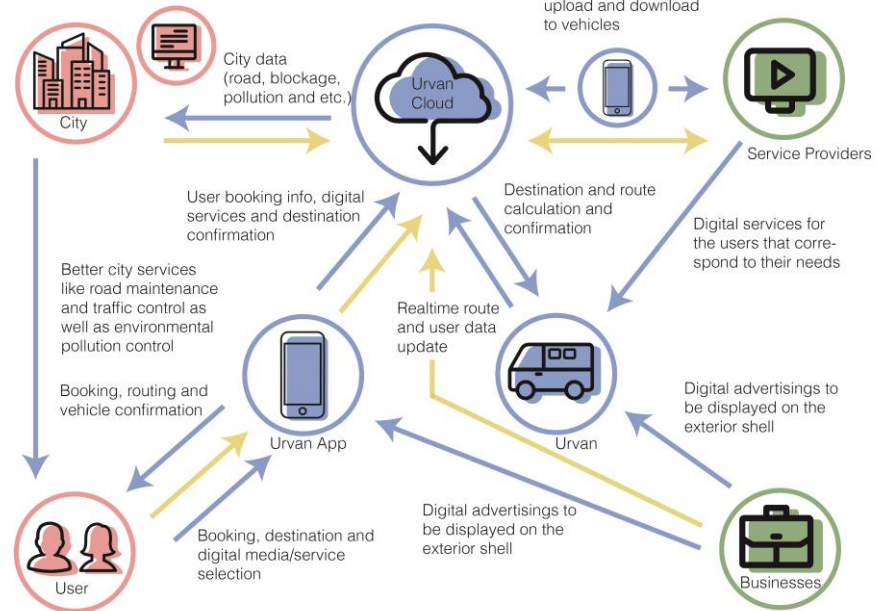
providers, third party digital service providers, commercial businesses and the Barcelona city hall. The frontend interactions happen between the users, Urvan service and the third party digital service providers, and the main goods and services exchange happens among these 3 stakeholders. Urvan system offers their vehicles and the digital app to the Barcelona residents as a mobility option within the city. Cloud maintenance service providers take care of the Urvan cloud updates and keep it working on high performance. Third party service providers interact partially with the Urvan system and the end user. Their interaction flow starts by providing their services to the Urvan system cloud and then use the cloud as the main digital touchpoint for their digital services to be bought and distributed. Digital service providers can only get in touch with the end user through the Urvan cloud. Commercial businesses have the same interaction flow as the third party digital service providers. They provide their digital advertisements to the end user through the Urvan cloud to the Urvan vehicles. Their main touchpoint or channel that reaches to the end user is the Urvan vehicles. Barcelona city hall is the largest stakeholder that benefits from the Urvan system. Their main interaction with the Urvan system is through the digital data that the vehicles provide to the city hall. Their interaction with the Barcelona residents comes as bettered city services.

System Map

DATA FLOW



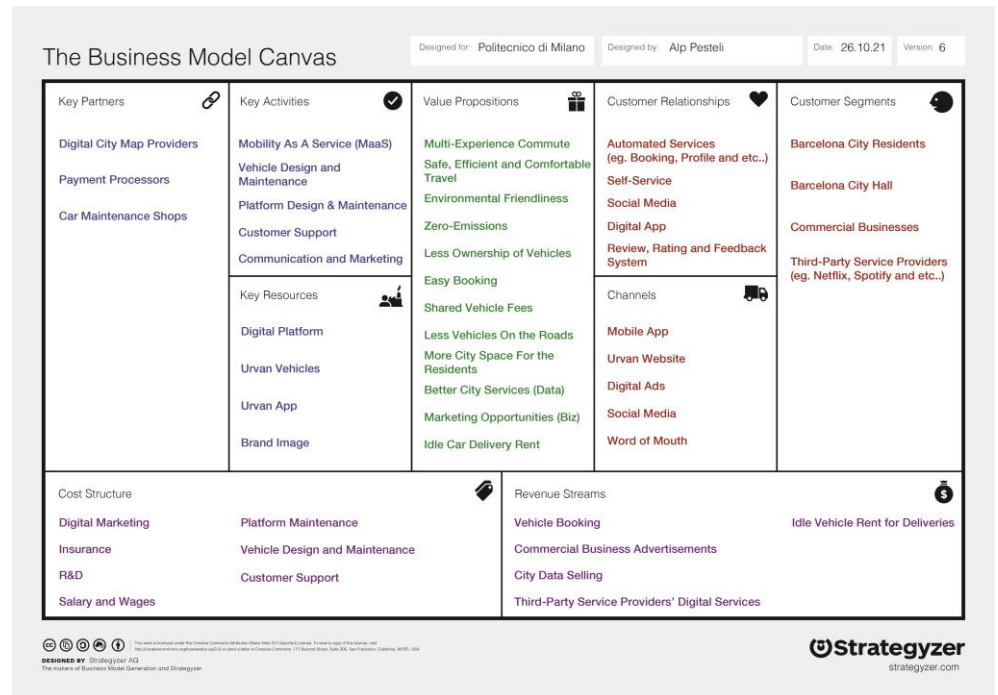
SERVICE AND MONEY FLOW



The system is comprised of 2 components. First one is the physical urvan vehicles and the second is the digital urvan app which contains the urvan cloud. Physical Urvan vehicles are special urban van designs which are electrical and autonomous and connected to the digital infrastructure of Barcelona. The Urvan platform and cloud stays in the middle of all the interactions amongst every actor. The monetary flow of any actor flows throughout the central Urvan app and gets distributed to their respective holders by the cloud. Users provide their preferences, data and monetary flow to the Urvan system which then gets distributed among third party service providers and the Urvan system. In return for the user data, third party service providers pay the Urvan system for what they receive. Moreover, another monetary flow from the third party service providers to the Urvan system is due to service providers purchasing digital space from the cloud for their application to be sold on the Urvan app. City hall purchases the collected city infrastructure data by the urvan vehicles from the Urvan system. Commercial businesses pay the Urvan system for the digital advertisement spaces of the urvan vehicles. The main service flow is from the Urvan system to the users in terms of providing the mobility service. Third party service providers offer their digital applications through the urvan cloud to the users as secondary services. Commercial businesses provide digital content to the users through the Urvan system. The major data flow is from the users to the Urvan cloud when the users create their profile by giving their data.

Commercial and third party service providers provide their product and digital service data to the Urvan cloud for further purchases or advertisements.

Business Model Canvas



Customer Segments: Barcelona city residents + commercial businesses + third party service providers + city hall. **Customer Relationships:** automated services + self-service + social media + Digital app + review, rating & feedback system. **Channels:** Mobile app + website + digital ads + social media + word of mouth. **Key Activities** Mobility as a service + vehicle design & maintenance + platform development and enhancement + customer support + communication & marketing. **Key Resources:** Digital platform + Urvan vehicles + Urvan app + Brand image. **Key Partners:** Digital city map providers + payment processors, Car maintenance shops. **Cost Structure:** Digital marketing + Insurance + R&D + Salary & wages + platform maintenance + Vehicle design & maintenance costs + customer support. **Revenue Streams:** Vehicle booking fees, advertisements from commercial businesses, data selling to municipality, third party service providers' digital services, Idle car delivery

Experience Model

The vehicles will offer in-vehicle experiences which range from mobile offices to video conference rooms to Netflix cinemas. The vision is to connect shared living with shared mobility by offering smart mobility solutions which are technologically advanced and connected by exploiting the information and entertainment services. Urvans are equipped with a variety of rich digital in-vehicle applications that bring enjoyment to users' daily routines which range from mobile working facilities to infotainment selections for fun or relaxation. Users have the possibility to download or purchase new applications along the way to the urvan that they have booked and change whatever experience that they want to live immediately. The change of experience through digital applications is done through real-time purchases on the Urvan app. Customization of the journey experience is available whenever a user books the service and the preferences are shared with the vehicle. Urvans work as the environment where the Barcelona residents interact with the service and the design of the Urvans enable the digital services to be embedded within the vehicles.

The service Urvan also aims to achieve an innovation of meaning in the transportation industry. It aims to revolutionize how people see transportation in the urban areas. Transportation will no longer be a waste of time during the day but it will be a time which people actually enjoy and utilize effectively without wasting it. As a mission, Urvan's goal is to make people's idea of using vehicles shift from ownership to sharing. It is evident that in the near future due to environmental, economic and social factors will tremendously limit the consumption and utilization of privately owned vehicles. As a matter of fact, Urvan creates a near future where using shared mobility actually becomes more beneficial since there is a possibility to utilize the commute time effectively by the digital technologies within the urvans. Urvan complements the shared living enabled by the superblocks design of Barcelona by bringing the concept of sharing economy to the mobility realm. There is a strong correlation between shared living and shared mobility since both aspects complement the lives of the residents as a whole. It is an opportunity to reduce the impact of human consumption behaviour on the planet without compromising the benefits that we get from it. Urvan offers a win-win scenario where all the parties benefit from the service without giving away utilities. The data buyers benefit from the service by acquiring user data, users benefit from it by having a low cost, easy, comfortable and fun way of travelling and commercial businesses have vast

possibilities to market themselves using this domain which is mobile all around the city.

FUTURE ENVIRONMENTAL CHANGES WITHIN THE EU – FUTURE SCENARIO

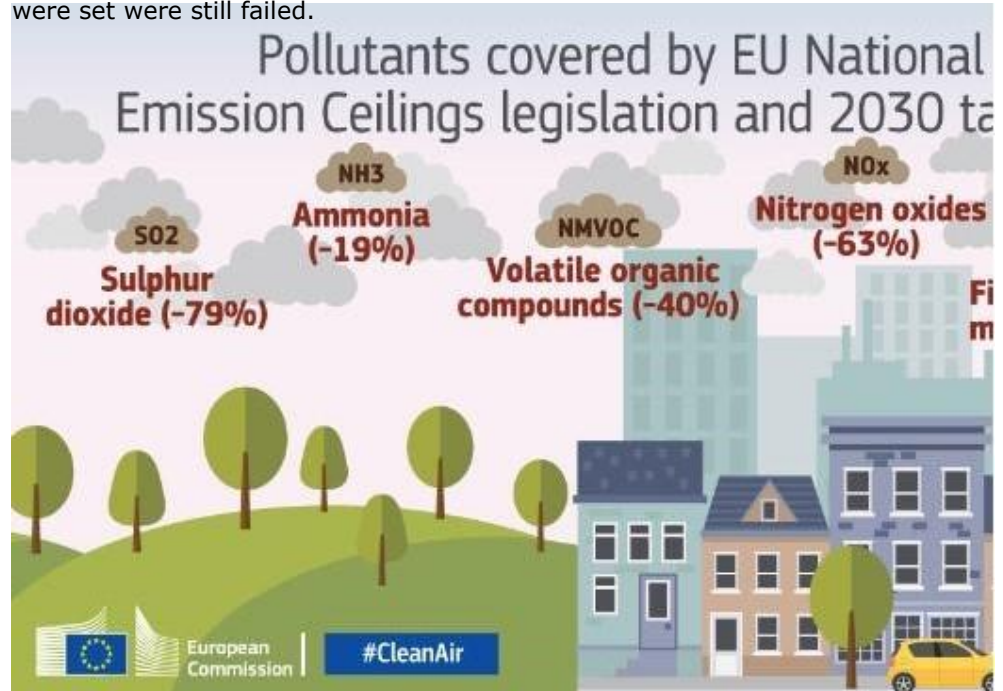
Future restrictions of EU

The European Union has one of the highest standards for environmental sustainability and these standards are taken under the guarantee by regulatory policies imposed by the European Union to the forming states. The aim of these policies is to protect Europe's natural resources as well as increase the overall wellbeing of the people who live in the European Union. The environmental policies or the Union's legislations protect air and water clarity, foster natural habitats, do proper waste management and help economies to move to a more sustainable economy. According to EUR-lex, in order to reduce the impact of the cities on the climate change, the European Union ensures the strategies and restrictions will be followed upon by taking a lead role international agreements. The most two prominent legislations are the Paris Agreement and EU Emissions Trading System. Under these agreements and legislations, the forming states have come into an agreement to meet the proposed targets in the coming years. The future environmental restrictions of EU land on 5 areas which construct the overall climate change. These areas are Air and Water, Noise, Soil & Forest and Waste Management.

Air pollution

The directive of national ceilings for atmospheric pollutants aim to put limits on 4 pollutants nationwide and these chemical pollutants are sulphur dioxide, nitrogen oxides, ammonia and organic compounds. The environmental effects of these chemicals to be present more than the ceiling limit of the European Union can cause acidification, water and soil pollution and ground-level ozone pollution. In order to prevent these chemicals to infuse into the environmental ecosystem, long-term EU policies and legislations will be implemented to set a ceiling consumption level. Every national government needs to establish certain national emissions and future projections to be submitted to the European Environment Agency every year to get approvals. In 2013, the commission has

declared that the air quality of Europe has increased; however, the targets that were set were still failed.



Biodiversity

The European Union has projected a 2050 goal for the preservation of natural habitats and biodiversity and the policies that target these future goals rely on three levers; Natural Capital, Resource-Efficient Economy and Healthy Environment for Healthy Residents. The natural capital focuses on protecting, improving and conserving the sea, land, drinkable water and clean air that construct the overall biodiversity. Resource- efficient economy refers to the process of moving the European Union into a low-carbon and resource-efficient economy. In order to switch to a more resource-efficient economy, the European Union has to make significant improvements on the environmental performance of products by improving and extending their life cycle. The mobility sector contributes to the degradation of the air pollution vastly and an increase in product life cycle and decrease in consumption mean a significant improvement. Another aspect is the decrease in the overall consumption and reducing food waste by using biomass sustainability. The overall strategy is to push the economy into a circular economy by reintroducing waste into the consumption wheel as resource and using more efficient use of water. Healthy environment for healthy people covers the aspects of human health and

wellbeing. The major factors that affect are air and water pollution, excessive noise and chemical usage. All of the forming states have agreed to increase the air quality and reduce the noise pollution by passing on noise legislations. Enhance the implementation of policies that are related to both drinking and bathing water. The poisonous chemicals and the chemicals that interfere with the human circulatory system should be tackled. The concrete actionable items are better implementation of legislations by providing better information that would improve the knowledge base, more and better investments for the environment and the climate and full integration of environment considerations to other policies. The main two prioritized goals are promoting sustainable cities and tackling international challenges.

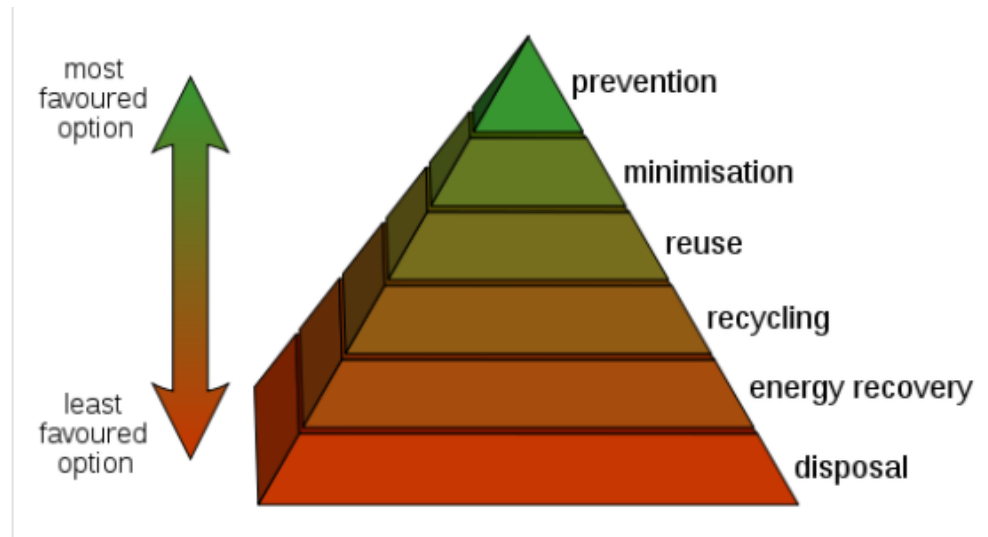
Noise

The European Union aims to implement regulations related to vehicle noise within the cities. The directive contains any combustion motor or electric vehicle on the road and imposes limit on the noise levels for the mechanical parts and the exhaust system. The main three categories that this directive takes into account in terms of mobility are cars, public transportation and delivery vehicles. The plan is to set limit values to the noise for the different categories of mobility options and a timeframe to implement the limits. For the electric vehicles, on the contrary; there will be a requirement for the electric vehicles to be equipped with acoustic vehicle alerting systems to increase for the lack of audible signals in the traffic that the hybrid electric vehicles lack. The aim is to increase the audio cues and the awareness of the drivers.

Waste management

The European waste management law aims to build a policy for treating the waste management law in the EU. The policy is designed to preserve the environment and human health by providing recycling, recovery and waste management systems to make the forming states move to a more circular economy. The waste management system offers the hierarchical system of prevention, reuse, recycling, recovery and disposal. The concept confirms the polluter-pay system where the polluter pays for the waste management and all the related environmental costs. With the directive, incentives towards introducing the waste as a resource into the production system increase since

polluter-pays principle puts the responsibility on the producer. Sustainable production and consumption models will be considered by the governments and establish incentives to design, manufacture and produce products that durable, reusable, recyclable and capable of having an extended end of life.



URVAN AND FUTURE OF EU

How Urvan Fits with the EU Strategy – Implementation Examples

In the future, the shared mobility strategy can be scaled up and implemented in any city within the EU. According to Salvador Rueda, the Superblocks model is replicable in any city and the starting examples should be taken carefully for the longevity of the success. The only prerequisite is to have a plan to implement and an architectural system like Superblocks. The urban planning system does not have to be in 1:1 similarity of what Cerda did in Barcelona but it has to propose a traffic-free network of living. According to Vance (2016), the system can work anywhere and the grid is not the necessary factor to implement. The urban planning systems must propose areas that are car-free and turn already existing structures into car-free blocks. The already existing city architecture or urban planning do not have to be in architecturally resemblance with the Superblocks, but the governmental organs or the local authorities should designate areas which then can be turned into blocks that resemble Superblocks.

Example 1: Chicago

One of the examples is in Ravenswood Manor in Chicago. The Department of Transportation of Chicago is testing an intersection point on Mabor Avenue to have a traffic diverter. The idea is similar to what we have in Barcelona; to effectively create a small traffic-free area in residential neighbourhoods. This architectural urban system trial is done under the project of 'neighbourhood greenway' project to create walkable districts that are traffic-free pedestrian plazas. The reason why Mabor Avenue was selected for trial is that it had a lot of traffic which made walking, biking and leisure hanging out on the streets dangerous and uncomfortable. Vance in his article states that he can clearly see the connections between the 'Superilles' plan in Barcelona, and what the Chicago Department of Transportation is implementing in small neighbourhoods. The phase of what Chicago Department plans is to convert the asphalt into space for other uses such as sports, games and cinemas.

Example 2: NYC

Another example is New York City. As data from smarcitiesandsport.org suggests, Barcelona is denser than New York having 53,119 inhabitants per square kilometer compared to 11,000 inhabitants per square kilometer in NYC. New York city is now turning its squares into 'Squareblocks', limiting traffic in some hours of the day and promoting local businesses to take the space and offer activities for the pedestrians to enjoy. Even though the NYC does not have the exact urban planning as Barcelona does, the city has turned their city squares into vehicle-free blocks which act in a similar manner as Barcelona Superblocks.

Example 3: Canberra

Still another example is 'Canberra model of self-contained residential development'. The idea was to re-route the traffic around the designated neighbourhoods and not through them. Even though the system worked, the model of Canberra failed on the aspect of sustainability of transportation. The city was designed around ownership of cars and the residential neighbourhoods

had declining populations. The model could have worked in all aspects if the city density was much higher and if the cars were fully restricted within the blocks as Barcelona did. The model then was proposed to other cities in Australia with the hope of having greener areas for habitants and traffic-free streets for children. Some of the other important cities in Australia that have received this plan were Adelaide and Sydney.

Example 4: Paris

Paris has tried to implement something similar to a Superblock. The city of Paris has tried to implement a 'polycentric' city model. This meant many small asymmetric centres within the city centre which was based on a 15-minute model. The idea was to have for most residents' needs within a 15 minute walk or bike ride from their home. This strategy was complemented by banning cars from the city centre on the first Sunday of every month.

The steps required to implement Superblocks in the EU

Implementation of Superblocks requires political act within the EU. According to Escude (2021), there are 2 major steps to be taken: citizen empowerment and tactical urban planning. Citizen empowerment requires a participatory process which is designed to cover the entire deployment of the infrastructure and seeks for the involvement and co-responsibility of the social fabric of each area. What kept the implementation successful in Barcelona was the continuous public opinion being heard in the participatory city hall councils. From the initial start, the process should start without making commitment to permanent physical changes. The initial commitments should be flexible enough for the changes to be reverted if not found applicable. The starting budget for the conversion should be low-enough to make trial-error adjustments as well as start experimenting tactical urban planning. This approach, just like in Barcelona, will enable the residents to reclaim their streets and decide on whether the newly implemented changes work for them or not. The complementary strategies should accompany the initiative to maximise the beneficial effects.

Challenges to be faced

Planning urban mobility strategy is the most crucial aspect of implementing Superblocks. As discussed in the example of 'Canberra model of self-contained

residential development' model, the transportation lever of the system plays a big role in the success of Superblocks. Implementing superblocks did not receive support from day one in Barcelona. The major challenges come from traffic and gentrification. What is meant by traffic is that it is not only focused on vehicle-prioritized traffic but rather a more holistic view on how vehicles and pedestrians move and circulate. The mobility plan of the Superblocks should take into account the pedestrian networks, bike lanes, new bus-lines which may or may not pass through each block, private vehicle network and an incentive for people to switch from private ownership of cars to shared mobility options. The second challenge arises as a consequence of improved quality of life and wellbeing. As a result of improved quality of life, the cost of living within the Superblocks gets higher and rents also increase. Real estate investors buy and rent houses to wealthy people and tourists which then leads to gentrification in these areas. In order to eliminate this challenge, increasing the number of Superblocks while preserving the social housing as well as maintaining the quality of living are essential. According to smartcitiesandsport.org, for the past 30 years, Barcelona had constantly increasing number of tourists. According to Rueda, capturing the same benefits of rural living (quiet, clear, air and water, green areas and gardens) alongside with the benefits of urban living is the key for the success of the Superblocks and eliminating the challenges to be faced.

Higher Managerial Contribution of EU

The European Union could ask as the accelerator of the shared mobility system of Urvan within the EU. Similar to the environmental pacts and policies, the Superblock system or systems alike can be set as the standard or reference for private housing system. The corresponding transportation systems similar to Urvan then can be linked to the urban housing system. Financial and physical incentives could be given to commercial businesses to develop their mobility systems and offer to the EU for competition. The European Union could pass these legislations to the forming governments as standards. For example, since there are environmental restrictions, mobility options like Urvan which are electric and environmentally friendly can be hired as service providers with monthly rates imposed on the taxes of the residents. The restrictions cannot be thought without new urban designs. Superblocks can be scaled and imposed to other cities all around the world.

CONCLUSION

Research Question

The Urvan mobility service aims to propose an alternative future mobility service for Barcelona which also has the possibility to be scaled up to any city in the world for staying within the environmental sustainability limits. The future of mobility from the signs of today, lies in high-tech smart city solutions that value people, environment and society at the same time. Barcelona, as a city, has chosen the path of introducing Superblocks to the city plan in order to arrive to a more livable and humane future for its residents. The choice was to transform the city into a smart IoT hub that collects data from every corner which in return gives the possibility to act on the environmental and social levers that cause pollution, congestion and discomfort for the residents. The main component that created environmental and social discomfort was the urban mobility. Since the early 2000s, private ownership of vehicles within Barcelona has increased to a level which caused air and noise pollution. In order to prevent further environmental pollution, Barcelona city hall has taken the lead to propose shared mobility options within the city. Shared city scooters, kick scooters and carsharing were some of the options that were provided to the residents. Urvan as a MaaS option for Barcelona aims to satisfy and incentivize the private shared mobility usage in order to reduce the overall pollution, congestion and consumption levels. Urvan promotes the wellbeing of residents and the healthy city attitude since the service brings out a system that benefits all the parties that come along. Shared living can be accompanied with shared mobility in Barcelona and become a complete service for reaching the city targets and the EU environmental city goals for the future. The opportunity to support shared living with shared mobility brings out a complete actionable approach to become sustainable.

The future of mobility cannot be speculated independently from today's expectations from the future in terms of environmental demands, technology, political constraints and urban planning. From the mobility and the automotive perspective, in the near future, the new standard will be automated electrical vehicles which collect data whenever and wherever they are online. The technology will become more accessible and cheaper than what is of today's;

however, the diffusion of usage for MaaS needs actions from authorities. Citizen participation and legal city hall partaking are essential in implementing services like Urvan. There is a switch in all the economies for shared service models which burst out from excessive consumption and environmental harm. The reason was to be more sustainable in terms of economic and environmental matters. The current model has come to its saturation where its harm is becoming irreversible on the society and the environment. The need for a better future both in terms of societal and environmental factors has led this change in economies. Urvan is a mobility option which resides in the future economic model that depends on sharing more than private ownership. Urvan will lower emissions, traffic congestion, gentrification, pollution and stay within the EU limitations of environmental limitations.

EU Environmental and Social Setting

The overall environmental damage and its corresponding effect on health and lifestyle on the residents have been steadily increasing for the past 20 years. The union has taken concrete steps to ensure that the environmental harm will no longer increase but decrease by pacts such as the Paris Agreement and the EU Emissions Trading System. Air pollution, biodiversity, noise pollution and waste management are the main levers that concern the EU environmental legislations and policies. In order to reduce the impact on both the environment and the societal wellbeing, the local administrations has proposed strategies to combat pollution. Natural resources are taken under the protection by the union and the services that construct the living within the city should comply with the standards that the union proposes. Urvan works within the limits with no harm to the environment while creating value for the society. Natural resources in terms of fossil fuels, air, soil and land stay unexploited and unharmed.

Urvan Service Remarks and Implementation

Urvan as a shared MaaS option emerges as an alternative form of mobility which has the potential to make Barcelona a smart and a sustainable city. It will aid the city in the favour of reaching the environmental goals and targets of the EU for the next coming years. It is a service for the future for Barcelona and for any other city which would like to be in the limits of the European environmental legislations. The service is an automated electrical urban mobility service which targets the Superblock residents. The smart vehicles work as private chauffeurs

for the Superblocks and work as city transportation vehicles when they are not booked by the Superblock residents. Urvans provide various data collection options for its stakeholders in terms of road/blockage data, pollution data and traffic data. The collected data is utilized to make the city better and increase the wellbeing of the residents. The expected outcome of this service is to make Barcelona stay within the European environmental limits by eliminating private ownership of vehicles and increase the shared mobility within the city. This way the total emissions within the city and the environmental pollution will decrease and the total number of cars on the streets will diminish giving more space for the people. Urvan works in the favour of giving more public space to the residents and make the residents live in a more liveable city.

The implementation of Urvan does not require upfront infrastructural changes; however, having a system like Superblock already implemented in the urban planning makes it more valuable for the city. The value comes from connecting shared living with shared mobility since the holistic approach of having to move to a shared economy increases the benefits both in terms of environment and the time spent while commuting. Shared living should be complemented by shared mobility in the urban areas in order to get the maximum benefit from it. The Superblock system accelerates the adoption of a system like Urvan within the urban areas since the main difficulties that the residents face are the traffic congestion, pollution and increased commute times. Smart and autonomous systems like Urvan eliminate these problems by having smart systems that adapt to changing user needs and behaviour. This system lowers the travel time by having connected IoT services and offer various entertainment options for the residents to have a pleasant time. Even though the mobility system works in accompany with an urban planning like Superblocks, the implementation requires political and voluntary acts. Smart and autonomous mobility options which are environmentally friendly should be incentivized by the European legislations in order to fasten the adoption within any city. The legislations should require firm environmental quotas and limitations on the usage of combustion engines.

Urvan Service Specificity and Value Proposition

Urvan is a Mobility as a Service (MaaS) option which aims to revolutionize the way citizens commute within Barcelona. The service is not solely an alternative option for public transportation but rather it is more of a holistic service which is integrated with how the city of Barcelona works as an urban planning. What

makes Urvan unique is the compositional factors that come together. Urvan being shared, autonomous, electrical and connected IoT with the city sets it apart from the already existing mobility solutions. Urvan is not a service which acts as an alternative mobility option for taxis or other public transportation means but rather it is a service which aims to replace private ownership of vehicles and preserve the city environment in the direction of EU environmental standards. Mobility in the future should be considered as a multi-experience transportation model which embeds digital entertainment options in the system. Without having to buy or own a vehicle, residents will have access to all the vehicles. The main value that the Urvan system brings is on the user and the environment. For the user, the easy, comfortable, fun and multi-functional transportation option which reduces travel time and congestion are key factors. Easy booking through a digital app which saves the digital preferences and uploads them to the vehicles before usage and the ability to share the cost of the vehicle with other residents are the secondary benefits to the users. For the environment, non-pollution form of transportation protects the longevity of clean environment. The overall value is for the society as a whole since the Urvan mobility service opens opportunities for third-party digital service providers, municipalities and commercial businesses to exploit the data and improve their offerings to the residents of Barcelona.

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ANNEX

Interview with 2 former Barcelona residents.

Paula Lujan Torrent – 33 years old – Lives alone in Granada - Operations Manager at Hugo Boss – Ex-Barcelona Resident – Spanish - Female

Marcos Cardoso – 39 years old – Lives in Stuttgart – Industrial Engineer at ETAS – Ex-Barcelona Resident – Brazilian - Male

Interview questionnaire: Paula Lujan Torrent

Part I : Icebreaker

How are you?

- Great thank you. Nice to meet you.

How old are you?

- I am 33.

Any sisters or brothers?

- 2 older sisters who also live outside of Barcelona.

What are you doing as a job right now?

- I am working at Hugo Boss as an operations manager. I calculate and forecast the future demand and propose inventory numbers. I am responsible for the women's wear side of Hugo Boss which is not huge but still important.

How long did you live in Barcelona?

- Roughly 20-22 years. 18 years without moving but after that I was on and off living in Barcelona.

Were you born in Barcelona?

- Yes I was born in Barcelona on 1988. My family is from Valencia but they moved to Barcelona for work. I did my Bachelors in Madrid and then worked there for around 1-2 years.

Part II : Questions on Barcelona and Superblocks

Where were you living in Barcelona? And how was it like to live there?

- I am from Barcelona but I lived in Granada for the most part. When I was in Barcelona in 2005, I was not living in the Poblenau area but I was frequently visiting the superblocks. Back then, the superblocks were a 'test' where the municipality made some social tests and looked for reactions from the residents. I think it was a good thing for Barcelona because the streets were full of cars and parking within the city was merely impossible. We had to park a block down the city and walk to our house and sometimes even paid for private parking. Apart from the parking there was severe traffic noise all around the city which you got used to but noticed once you were inside your house. It was barely healthy and everyone knew about it. My dad told me that after the Olympics of 2002 or 1998 I am not sure, the visitors from the other countries and cities had actually noticed the air and noise pollution of Barcelona. It was the time when Barcelona came into the headlines of newspapers as the dirtiest city of Spain probably. I enjoyed living in Barcelona because I was young and going to the school and spent my time indoors all throughout the day; however, I suppose it was not really healthy to live there.

What do you know about the superblocks?

- It was designed by Cerda I don't know when but ever since the grid system is preserved and city has been enlarged using the same system. Basically, the city of Barcelona sits on a grid system where the pattern spans across the city. All of the blocks have been designed to have a square shape and have an interior public space. This shape makes the city very planned and easy to move around. I think the city is trying to enlarge the superblocks throughout the city border to prohibit traffic flow within them. It is good for the citizens because parking and traffic were unbearable.

Why were the Superblocks done and how did the residents respond?

- I believe it was the act of the Barcelona municipality who made the initiative. As I said before, during the early 2000s the city was an inhabitable city with a lot of pollution and traffic. It is a beautiful city but it was almost impossible to move around especially at peak hours. I had a car since I was 18 but never felt comfortable moving around with my car after work or before work. During the day, it was fine because everybody was working, but during the rush hours it was a nightmare. I actually think that it is beneficial for the city since it curbs traffic and limits cars inside the blocks. People of Barcelona need to enjoy the city more and we deserve a greener city. It is not fair to be living in a rich city with such pollution levels when you pay the taxes. We did not really have enough space to sit around and enjoy when I was young. We either had to go to a place and pay for drinks and sit or go to the Ciutadella. I hope the system gets implemented in every block since it is a win-win. I do not really care if it limits the driving since it is at a ridiculous rate right now. Almost everybody owns a car and if you think about it, it is impossible to walk on the streets or sit and enjoy. It is really overcrowded by cars and residents need more space.

What is special about the superblocks?

- I do not know technically what is the thing that makes the superblocks different or special, but the thing is that it makes the blocks more social. There are parks, green areas, and even sometimes people put chairs out and put music to have a good time with the people that they live with. It creates a great environment to be in and it reflects the vibe of the city as well. I do not know anyone living there and I have not been there as well so I cannot specifically specify. It also adds value to the city too, the housing becomes more accessible since the traffic gets curbed and people can buy housing even further away from where they work. I suppose environmental preservation becomes higher since inside the superblocks it became greener. We will wait and see if this can be successful city-wide. People who live there obviously talk about how it is better than before and I can see why it is better.

What do you think the most impact that these superblocs brought to the city?

- From my perspective, it made the city more livable. The main problems were pollution and traffic and it solves them. Now people have more areas to roam free and enjoy. It also gave hope to the citizens of Barcelona since now we know that the problems we face can be solved and will be tackled. I think the most impact was on the daily happiness since people spend less time stuck on the traffic and enjoy more free time. Spain is not a rich country but Barcelona once was and still is I believe, and people deserved more from the government and the municipality. People now enjoy more and live a healthier life. I think the numbers of sicknesses that were dependent on pollution and car crashes have decreased significantly. I am not saying this is 100% the cause of the Superblocks but it has also changed the way of living. People started to use more public transportation now because it became more accessible and easier than before. Nowadays the transportation has developed a lot due to shared mobility provided by companies. There are motorcycle sharing and car sharing options available anywhere on the city. City scooters have unlimited options to roam free. The Superblocks made the city lighter giving more opportunity for opportunities like these as mobility.

Why did you own a private vehicle?

- It was almost impossible to move around when I was in Barcelona. I was living on one side of the city with my family and had to commute to the other side. It was not easy to do that back then with public transport. I would have spent more than an hour everyday just on the road to get from A to B. We did not have shared mobility options as well back then and either you had to take the public transport or have a car.

What do you think about the city of Barcelona?

- It is a beautiful city and it is becoming better and better day by day. It was once the economical capital of the city but now I think it is not. It is a prosperous city.

What was the most irritating environmental or social factor of Barcelona?

- Definitely the pollution. You would not be able to talk in your regular voice when you were walking on the streets or having a good time outside with your friends. The air has always been dense and polluted even though Barcelona has never been an industrial city. The windows of our apartment were gray almost everyday; we have thought it was dust but it was not. The regulations have changed this tremendously also there were new standards set to the cars and their exhausts. This decreased the overall pollution. I am not sure how they dealt with the noise pollution but what I know is they put some sort of sensors all around and measured how bad it was. I do not know if they have acted upon it with the sensors or not.

Part III : Questions on Barcelona mobility and public transport

Were you using public transportation?

- Not really. My family used to drive me to school, but occasionally, I had to take the public transport to go to my school.

Why or why not were you using public transport?

- The commute time was too much for me. I could not use a bicycle because the distance was too much. That is why my family drove me all around or I had to call a taxi. It was not something impossible but it was something very inconvenient.

What was the most difficult thing about the public transport?

- Time and comfort, but with the mobility sharing options I do not believe it is unbearable. Sometimes it becomes expensive because the sharing mobility is not available all the time. You need to look for it and you need to walk or get to where they parked. Of course electrical scooters are everywhere but they are not for everybody; imagine being a family of 3-4 and you need a transportation means at 10 pm. It is not very

easy to find all at once or on demand. It solved some problems but not all problems.

What type of mobility were you using?

- Before owning a car, I used public buses and my own bicycle. Besides these, I frequently used shared city bikes and electric scooters because locking your bicycle was not safe. You always had bicycle theft within the city. It was not everywhere and anytime but you had the fear anyways, so I used shared bike and scooters to avoid my bike getting stolen.

What do you expect to see more in the future in Barcelona in terms of mobility?

- I expect more electrical vehicles. More scooter and cars by the municipality and private brands. It is not peculiar to Barcelona only but also to any city in the world. Cheap shared or private electrical vehicles. Maybe more autonomous private vehicles.

What would you think of having semi-public shared mobility for each superblock?

- It sounds interesting. If it makes transportation easier and faster why not? It would be nice to live in an apartment where you also have your dedicated mobility for that specific apartment.

Interview questionnaire: Marcos Cardoso

Part I : Icebreaker

How are you?

- Very good, how are you?

How old are you?

- I am 39.

Any sisters or brothers?

- I have 4 other brothers who are in San Paolo.

What are you doing as a job right now?

I am an industrial controls engineer at ETAS. I measure and conduct tests on software stacks which are related to smart cars.

How long did you live in Barcelona?

- Around 4 years for work reasons.

Part II : Questions on Barcelona and Superblocks

Where were you living in Barcelona? And how was it like to live there?

- I lived in Horta Guinardo which is the north-west of the city center towards the outskirts of the city. It was more affordable there and it was closer to where my wife worked so we chose to live there. It was very green since we were near the outskirts of Barcelona and it was less crowded. We really enjoyed living there because we liked being in a quiet place. There were small neighborhoods and historical places too so it was actually a pleasure to live there.

What do you know about the superblocks?

- All I know is that it is an architectural engineering system that relies on a squared type of buildings. I don't know when and who did it but if you walk the downtown Barcelona, you could see the structure. It gives an order and predictability and I liked it. I assume the living is more costly there since districts with these city designs usually have more rent because of better infrastructure and city services.

Why were the Superblocks done and how did the residents respond?

- I do not know specifically why it was done but from my wife I know that they were done to have a controllable city. I think it was a part of Barcelona city planning and growth. The city municipality wanted to have scalable infrastructure and controllable city. It is good for the order I think because in this way you can plan which area will be dedicated to which kind of housing or will it be open area. The residents should have liked it because it makes the city more livable if you have a city which is actually designed rather than just having firms build buildings and sell them without prior plan. I would have liked to live in one of these superblocks to be honest if I had the economical power. It is much more orderly and feels designed.

What is special about the superblocks?

- I don't know the technicalities of the structures but from what I saw and observed from my time there is that people actually enjoyed spending time around or in them. It gave spaces for people to hang out and have open air cinemas or parks, children played football and residents used it for individual parking. It is like owning a house and owning a social environment as well. I think the specialness of the blocks does not come from its technical aspect but from its social aspect. I really never cared about how they were made or what was the reason. From an external perspective, having social areas near your house where you can hang out and don't have to take a bus to go to somewhere is a very good idea.

What do you think the most impact that these superblocks brought to the city?

- The only benefit that I saw and experienced there was that children were free, people were hanging out outside and people had more space to themselves near their homes. The social space is full of green and parks for people to sit and enjoy. It affects people's psychology and happiness more than their biological health. I believe people who live there are happier than us. The reason why we chose to live in Horta is because of the green areas and less stress from the city. It affects

people's overall mood and the way of living. Me and my wife had very small ring of friends and we would have loved to be more included in the culture. We do not speak Spanish and not a lot of people rely on their second language to make friends. We would have loved to be in an environment where we did not have to push ourselves to be included in the society. It is a win-win, on one hand you have better city control and order and on the other hand you have happier people. This is just my perspective though.

Why did you think that people who live there are happier?

- I am just empathizing. Imagine not having to drive, cycle, walk or take a bus to go to a place to hang out with people whom you like; or, having spaces near your house where you and your friends get together and hang out. No money required, no transportation required and no stress embedded. This is how I see it. If I were to live in one of the blocks, I would be much happier than I was back then living in Horta. Having your house next to a green area with people you like and no transportation time.

What do you think about the city of Barcelona?

- Barcelona is a very vibrant city with people who like to enjoy life. It is very much like Brazil and San Paolo. People are out all the time, the weather is fantastic and people are friendly. I would not say that it is as small as Stuttgart but it is not a huge city. I liked living there but it was really expensive when compared to what I earned. The housing was extremely expensive, and I did not really enjoy that bit. I am accustomed to using a bicycle or a motorcycle since in San Paolo I rode both. The traffic is 'the' most difficult thing in Barcelona. Everyone has a car and everyone drives it every day. The reason why we rented a house in Horta is because my wife hates public transportation and her work was near our house.

What was the most irritating environmental or social factor of Barcelona?

- The traffic. It is unbelievably congested and people literally spend a quarter of their day on traffic. I hacked it with a motorcycle but I know it is a huge pain. Sometimes it is really hard to walk as a pedestrian as well since wherever you go there are either parked or congested cars on the streets.

Part III : Questions on Barcelona mobility and public transport

Were you using public transportation?

- No I had a motorcycle. Well I used it when we first got to Barcelona but I don't really remember how good or bad it was because it was for a very short amount of time.

Why or why not were you using public transport?

- I had a motorcycle and the traffic was crazy. I wouldn't want to spend half of my day just sitting in a bus waiting to go home or work.

What was the most difficult thing about the public transport?

- Maybe everything. I do not know. It was very standard.

What type of mobility were you using?

- Before getting this motorcycle, I used the public transport twice or one time a day. I use my bicycle a lot. Sometimes I use city kick scooters for fast travel if I don't feel like driving or when I am out drinking.

What do you expect to see more in the future in Barcelona in terms of mobility?

- I expect less traffic. More roads or less cars. I don't know how but it is a must.

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