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Next generation **mobility services**

EDIT Summer School 2016 / Business Analytics

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Introduction

Comtrade has been organizing the EdIT Summer School for 20 years. This year, the topic for the Business Analysis group in Ljubljana was Next Generation Mobility Services. The group consisted of international participants from Slovenia, Germany, Macedonia and the Netherlands. EdIT is the perfect environment for students to expand their academic knowledge with practical experience and to test their teamwork skills. The students were developing a future mobility system for two weeks. The first milestone was a presentation at the end of the first week, and by the end of the second week the system was defined in greater detail and this vision was captured in the following document as a joint group effort. The document introduces a visionary concept of mobility services to include state of the art technologies, focusing on predictive analytics, autonomous driving, electric vehicles and smart infrastructure. The system is generically introduced and applied to the city of Ljubljana. Various use cases are examined as proof of concept.

As a basis for starting their brainstorming session, the students were provided with the following introduction to the topic:

Modern cities are often polluted, overcrowded and slow-moving. But, nevertheless, the number of people moving to cities keeps rising. The existing mobility network is incapable of adequately serving the needs of all those people, and because public transport cannot provide a comprehensive solution, the majority of people still prefer the private car over other mobility services. Society has been aware of that issue for a long while now and a few things have already been changed and developed. Mobility has already been digitalized, and services such as car-sharing, ride-sharing, shuttle services, private drivers and public transport have been also implemented. However we are still far from a smart, well-deployed, integrated mobility solution for public transport.

Reasons for mobility changes

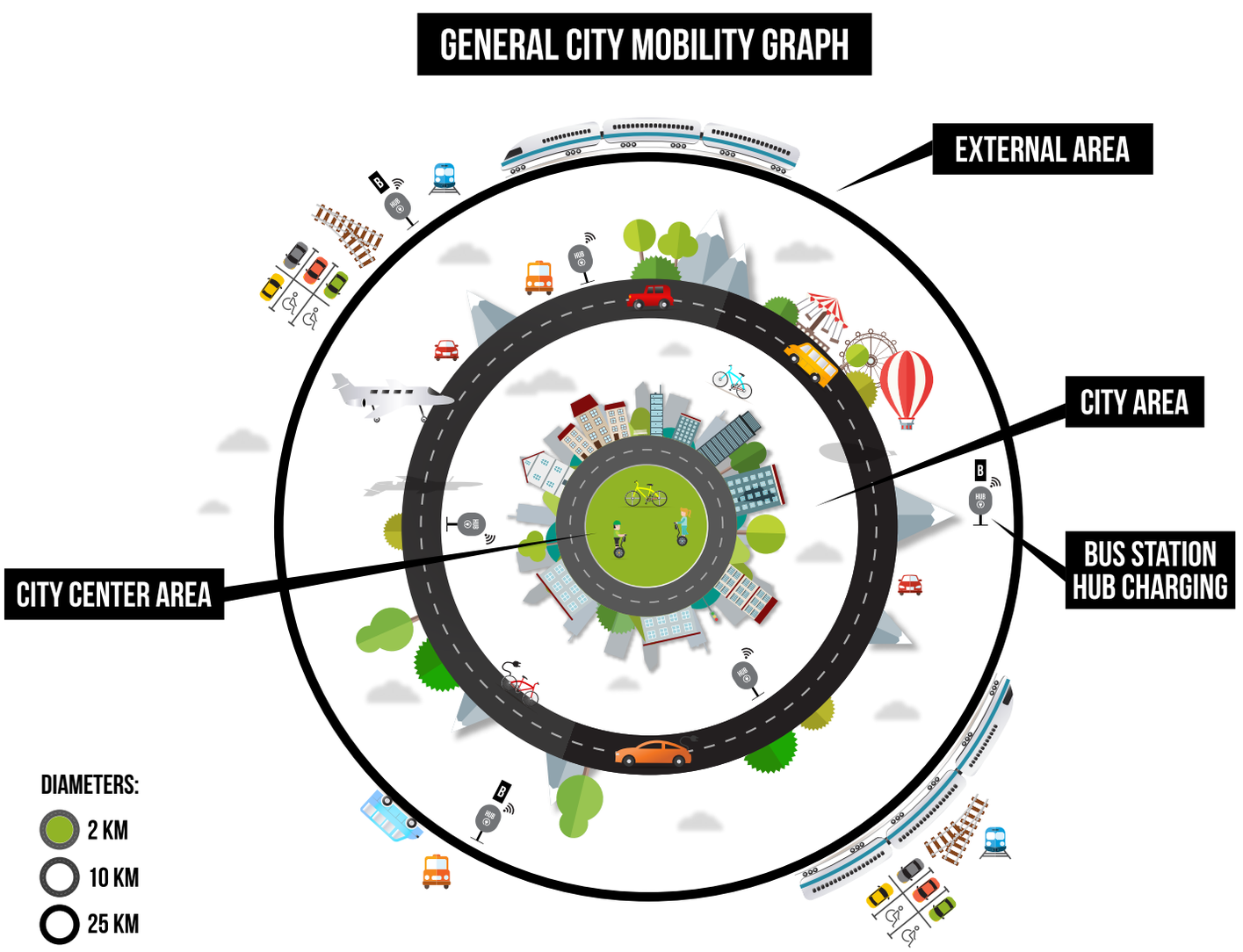
Demographics, urbanization, enabling technology, climate change and the rise of the individual are just some of the megatrends that are challenging future mobility in cities. Besides these, heavy traffic, long commutes and environmental concerns such as air pollution and limited resources are serious reasons to consider alternative concepts of mobility. At the same time, new technologies, as well as political and financial issues, are bringing urban mobility to a tipping point. Cities have the chance to provide people with easier and better ways to travel, while making their communities more livable and sustainable. Seizing that opportunity will require new kinds of mobility services in the future.

Vision of Urban Transportation

This visual graph represents a general view of urban transportation and mobility in an urban (smart) city in which several aspects of the future of mobility are considered.

The city of the future will consider the trend of discouraging private vehicles and car ownership, which is likely to continue in the future, bringing potential high disruption in city mobility.

Sustainable urban mobility is an important dimension in an urban area, and it is one of the key concerns of city sustainability. From that perspective, new and on-demand mobility solutions can transfer car ownership to new business models for fast and sustainable mobility, in the long run shifting away from private car ownership to shared mobility.



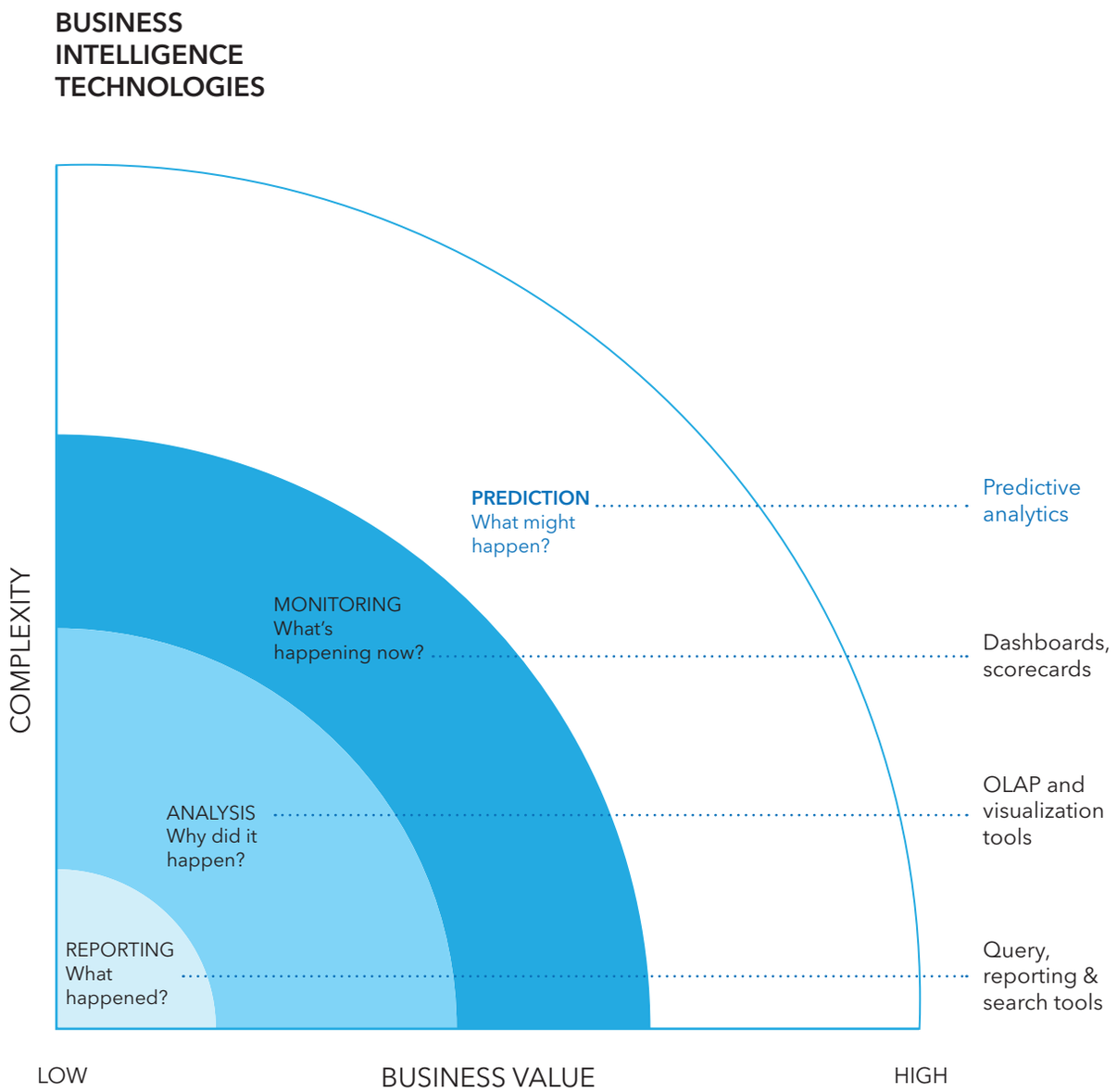
This graph represents a city divided into three layers, the city centre area in which only walking, bikes and segways will be used for mobility. In the city area, multiple options for mobility can be used; people can use shared electric scooters, bikes and cars, and also micro-cars or one-seater cars for fast and environmentally-friendly mobility. In the extended or external area, it is considered that there will be more connections, as long as the trend for movement to urban cities continues to rise and cities grow faster than highways can expand.

The external area is connected by circling electric buses and mini-buses linking urban train and railway stations. Also, hub stations for charging electric vehicles, parking, and renting e-bikes, e-scooters, and e-cars will be located there so people can choose their own personal mobile solution to reach the city area, where hub stations are also positioned, or to go to the main city centre.

Because the requirement for parking spaces will be diminishing, this solution can open up new free space which can be used for more green spaces and parks, new playgrounds, and sports facilities like swimming pools; in general, this solution puts the human in a more centred position and offers freedom of mobility for everyone. With fewer cars, urban areas will be more environmentally-friendly, creating an area with less CO2 emissions, which is an important vision for urban spaces and cities of the future.

Predictive Analytics

Predictive analytics is a set of techniques and technologies that mixes together statistics, modelling, advanced mathematics, and artificial intelligence, adding a heavy dose of data management to create and determine future performance patterns based on existing and past data. Predictive analytics is a set of business intelligence (BI) technologies that uncovers relationships and patterns within large volumes of data which can be used to predict performances, patterns and events. Predictive analytics is forward-looking, using past events to anticipate the future.



Example: "An airline increased revenue and customer satisfaction by better estimating the number of passengers who won't show up for a flight. This reduces the number of overbooked flights that require re-accommodating passengers as well as the number of empty seats." [1]

1 Predictive analytics - Extending the Value of Your Data Warehousing Investment by Wayne W. Eckerson

Predictive analytics can help companies to optimize existing processes, better understand customer behaviour, identify unexpected opportunities, and anticipate problems before they happen. Almost all of TDWI's Leadership Awards winners (for excellence in data warehousing and business intelligence)[2] in the past six years have applied predictive analytics in some form or another to achieve breakthrough business results.

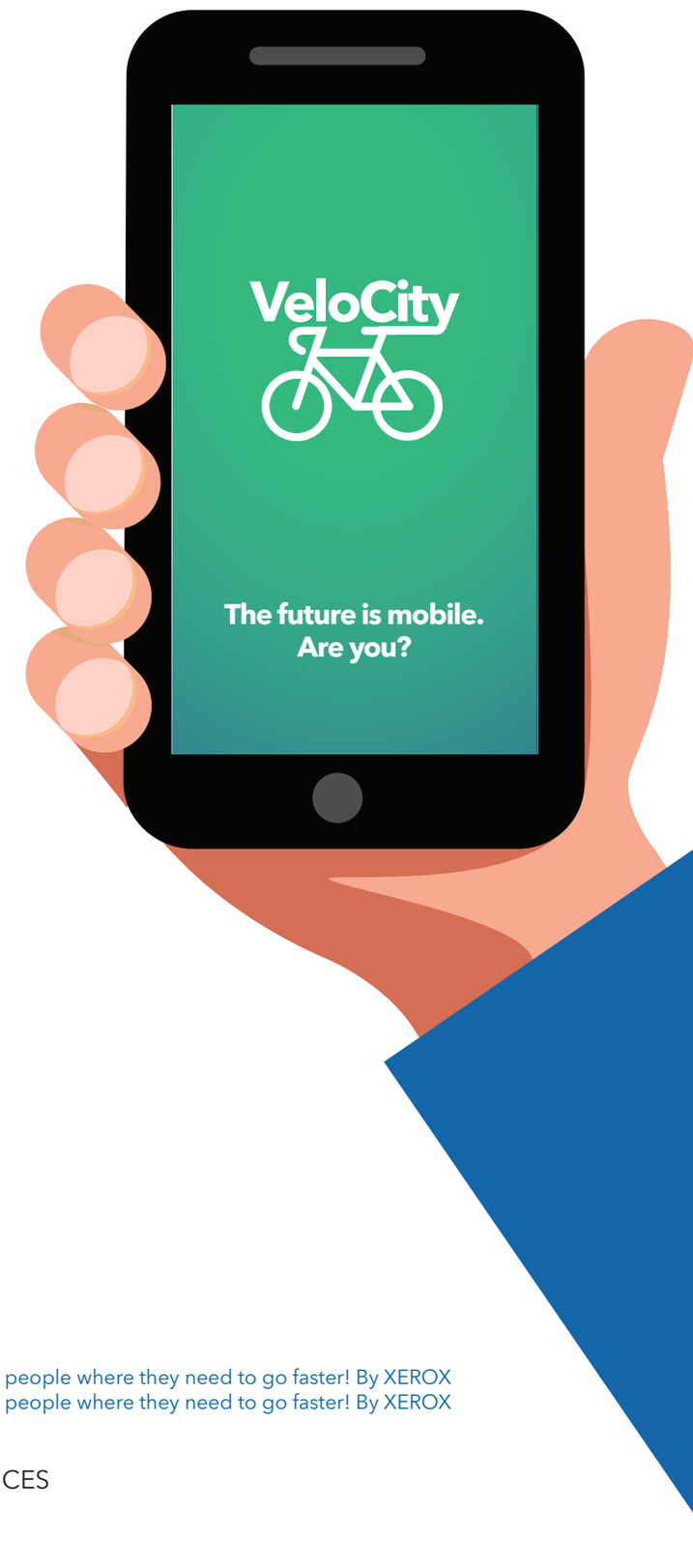
Predictive analytics can be used to suggest modes of transport or routes based on previous travel behaviour and the user profile of the customer for driving efficiency, reducing congestion, and getting people where they need to go faster. Mobility as a Service is a relatively new concept with relatively few users and little data on previous travel behaviour of specific customer profiles, and so far it is not very well developed within the Mobility as a Service system.

Predictive analytics in MaaS functionality supports automated decision making, such as continuous updates of network caches based on where a user is expected to move to next, or the offer of dynamic suggestions based on predicted service usage. In the MaaS structure, predictive analytics for the prediction of future events can use parameters which are also available in Ljubljana, such as the forecast weather conditions, temperature, humidity, rain, cloud and sun periods, motorway traffic, amount of traffic, traffic flow and distances, live weather conditions, parking place constraints, traffic counters on highways and traffic density to make predictions on routes and mobility solutions for personal behaviour in an digital application for the fastest and best mobility and choice.

Predictive analytics can be used to enable transit operators to make decisions quickly for real-time adjustments of vehicles or services. For example, are there more people waiting for a specific bus than that bus can hold? Additional vehicles can quickly be added to handle the overflow. Is there a traffic accident along a specific route or roadway? Analytics enables sources to gain the knowledge they need as events occur to reroute those vehicles to get people to their destinations on time.[3]

Push notifications can be sent automatically to users of the mobile application about the weather forecast for the next day, recommendations for the best route based on traffic data or the best sustainable choice of vehicle for that specific transportation.

Google processes real time traffic data to forecast travel times in Google Maps.
TomTom automatically redirects you if real time data detects traffic jams.
Travic maps displays transportation in real time and allows the modelling and prediction of the effect of changes in a public transport network (delays, extension of the network, and increase/decrease in commuters).



2 Transportation Analytics, Driving efficiency, reducing congestion, getting people where they need to go faster! By XEROX
3 Transportation Analytics, Driving efficiency, reducing congestion, getting people where they need to go faster! By XEROX

Gamification

Gamification is defined as “the use of game design elements in non-game contexts”. The most commonly used gamification elements are points, badges and leader boards; more advanced ones include levels, paths, challenges, missions, feedback, and user powers. Gamification has been successful in many domains. It inspires fun, competition, rewards and game mechanics in ICT-mediated contexts for marketing, motivates employees to work towards specific enterprise objectives, or incentivizes virtuous behavioural changes in society at large; for example, it has been shown to motivate people to have regular physical activity or to achieve energy savings. [4]

Gamification can influence citizens’ behaviour in relation to many of the concerns of a city, such as participatory governance, tourism, culture, education, and so on. From that perspective, a gamification element in a MaaS application can motivate people to collect points for choosing “greener” options for transport, and depending on their CO2 emissions, more points can be added to their application profile. Another example is people collecting points for the number of miles/km of walking or biking and being rewarded by a free coffee, sponsored by a participating café or restaurant.

New vehicle communication systems

Car-to-car and vehicle communication will allow a number of things to happen. Cars will be able to broadcast their location, speed, steering wheel position, brake status and other data to vehicles within a vicinity of a few hundred metres. Other cars can use this information to build a detailed picture of what is unfolding around them. A connected car is a one which is equipped with internet access and usually also with a wireless LAN. Thanks to “multi-hopping”, a network can extend over a much greater distance than 1km. Connected cars will use the Internet of Things.

The first generation of a vehicle-to-vehicle system could warn drivers of potential dangers without taking control of the car. The benefits of such a system include alerting the driver, improved safety, information sharing, collision avoidance, reducing congestion, improving traffic flow and reducing enviromental impacts. NTHSA says that 81% of all multi-vehicle accidents could be prevented by a vehicle-to-vehicle system. Each car would be equipped with a radar or ultrasound for obstacle detection, cameras, and sensors for speed, location and brake

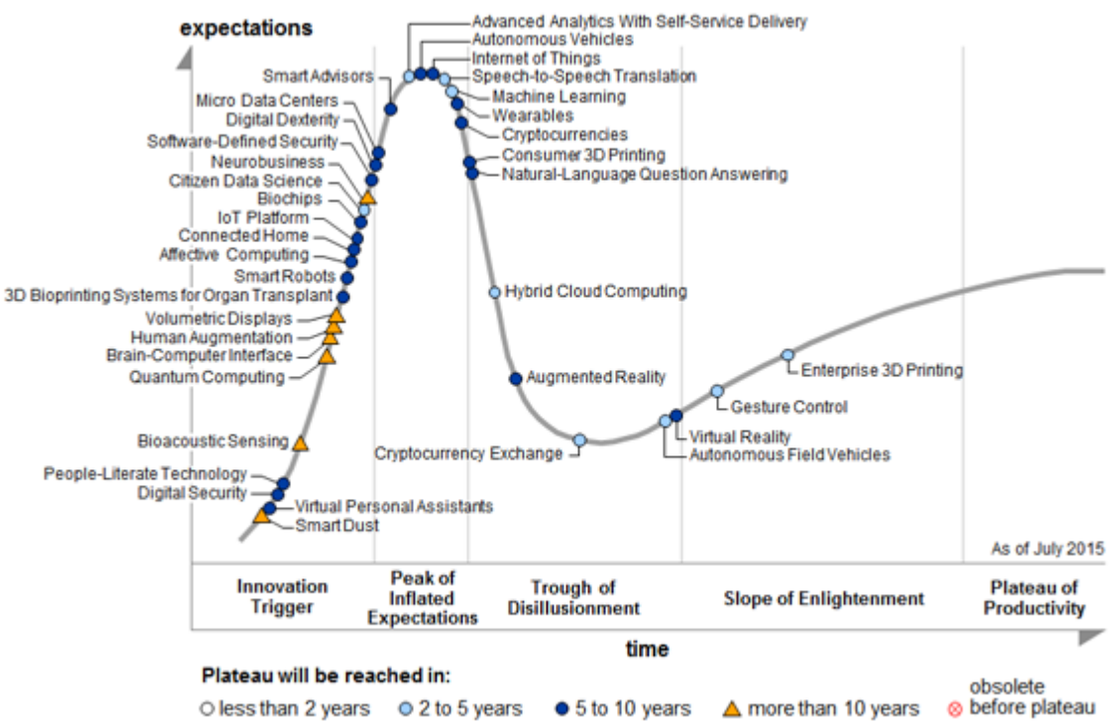
4 Gamification to Incentivize Sustainable Urban Mobility

status. Vehicles could also share data with other infrastructure – for example, traffic lights.

Such a network would also face certain challenges. It would require a dedicated portion of the wireless spectrum and possibly a new wireless standard.

Automotive manufacturers would have to agree upon certain standards. There is also the question of cybersecurity and privacy.

Autonomous driving



Source: http://www.gartner.com/newsroom/id/3114217

Up to now, the auto market has been slowly progressing through different stages of automated vehicle classifications:

Level 0: The driver completely controls the vehicle at all times.
Level 1: Individual vehicle controls are automated, such as electronic stability control or automatic breaking.
Level 2: At least two controls can be automated in unison, such as adaptive cruise control in combination with lane keeping.
Level 3: The driver can fully cede control of all safety-critical functions in certain conditions. The car senses when conditions require the driver to retake control and provides a "sufficiently comfortable transition time" for the driver to do so.
Level 4: The vehicle performs all safety-critical functions for the entire trip, with the driver not expected to control the vehicle at any time. As this vehicle would control all functions from start to stop, including all parking functions, it could include unoccupied cars.

Level 5: Other than setting the destination and starting the system, no human intervention is required. The automatic system can drive to any location where it is legal to drive.

For example, lane keeping, adaptive cruise control, parking assistance, etc. are already being used at level 2 and partially at level 3, which is where the state of the art of automated driving is today, but these are mainly implemented as luxury features, which are being offered primarily to increase driver comfort. Now the mobility sector is preparing to reach level 4 and level 5, which means totally autonomous vehicles, and this is expected to open some new groundbreaking possibilities. Computers can use much more information in the course of their decision-making and can do it faster than human drivers. In combination with V2V and V2I communication, their advantage grows even further. Autonomous driving will save drivers a lot of time, which they will be able to spend on work or relaxation instead of focusing on driving. There would also be an improved ability to manage traffic flow, combined with a reduced need for traffic police, vehicle insurance etc. The area required for vehicle parking would also be lessened, as these cars would be able to go where space is scarce or they would constantly be on the move, picking up the next person in need of transportation. The vehicles' increased awareness could reduce car theft, while the removal of the steering wheel – along with the remaining driver interface and the requirement for any occupant to assume a forward-facing position – would give the interior of the cabin greater ergonomic flexibility. Large vehicles, such as motorhomes, would attain appreciably enhanced ease of use. When used for car-sharing, the total number of cars would be reduced. Furthermore, new business models (such as mobility as a service) could develop, which would aim to be cheaper than car ownership by removing the cost of the driver. Finally, the robotic car could drive unoccupied to wherever it is required, such as to pick up passengers or to go in for maintenance (eliminating redundant passengers).

Improvements in current urban mobility systems

The current mobility system is functioning essentially on scheduled public transportation, which is not really adequate, and private vehicles. In the following chapters, detailed improvements will be considered, distributed throughout public, individual, on-demand, shared and non-motorized transportation.

Public transportation

Public transport today is the backbone of many urban transport systems. A wide array of available options, routes and vehicles tries to cover as many of the needs of its users as possible. As it stands, public transport still faces a variety of problems and leaves a lot of room for improvement. The main problems are waiting times, carbon emissions, current ticketing systems and long travel times.

Electric buses

Modern cities have a lot of issues with carbon emissions and other forms of pollution. Of 6870 million metric tonnes of carbon dioxide emitted

in the U.S. in 2014, 26% came from the transport sector. Obviously the transport sector is not only limited to public transport, but it definitely contributes to the emissions.[5]
Electric vehicles have almost triple the energy efficiency of petrol/diesel powered vehicles – around 60% compared to a mere 20% – and emit zero pollutants.[6] An electric bus passenger survey done by Volvo in Sweden showed an increase in user satisfaction. Most of the passengers said that they liked how quiet the buses were and also that they liked using public transport, knowing it causes less pollution. The main benefits of electric vehicles are no noise and air pollution and higher energy efficiency, making them perfect for urban areas. The current issues that electric vehicles or their would-be owners are facing are the high costs of batteries, which are fortunately decreasing, and low battery capacity, as an electric bus has to be recharged more often than a petrol/diesel one. We will definitely see an increase in electric buses on the streets in the future; the switch is already happening in cities like Vienna and Gothenburg.

Aerial ropeway transits

Mostly seen in skiing resorts or in industrial zones, aerial ropeways are starting to make their way into urban areas. Being able to pass over natural and urban obstacles alike, ropeway systems could be a great addition to cities. They can be placed in very crowded cities, as the only components taking up space on the ground are the support pillars and end stations, as well as in cities that have a very dynamic landscape. They also have the added benefit of being powered by electricity. Ropeways are being developed in countries like Turkey, Germany and Brazil. The major downside is that they require completely new infrastructure in order to operate.

Smart cards

Smart cards are seeing immense success in Hong Kong, a city with one of the two best public transport systems in the world (the other being Amsterdam, as ranked in a study made by Arthur D. Little[7]). The card solves the problem of having to buy separate tickets for different public transport vehicles, and indeed having to buy physical tickets at all. Hong Kong's Octopus Card not only unifies ticket payments, it can also be used to pay for an ever-expanding list of other services, from fast food to convenience stores. In fact it is extremely popular and one is owned by 95% of all people in the city between the ages 16 and 65[8]. Such cards can also be used to track passenger and consumer habits for the purposes of predictive analytics.

Predictive Analytics of public transportation

Predictive Analytics can be used to improve various aspects of public transportation. With the trend towards the Internet of Things being on the rise, public and personal transport alike will be connected to the internet at all times. This means that data useful for improving the public transport user experience will be readily available. For example, bus stops could send data to buses about the number of passengers waiting. The bus would also know the exit stations of all its current passengers. Empty stops, at which no passenger will either board or exit could be skipped entirely, reducing trip times. Furthermore alternate routes could be given and customer behaviour could be predicted by the weather forecast.

Individual Transportation

City centres are becoming more and more restricted to pedestrians and cyclists, but the average person is only willing to walk up to around 600m, and cycling might be a problem because of the weather or luggage. So in an urban area there is a demand for different transportation options (vehicle types) which would help individuals to overcome the first and last mile problem, when the distance exceeds the aforementioned 600m. So in this sub-chapter some promising options for individual transportation vehicles will be presented. They are all smaller and more agile than most options currently in use, which brings benefits of higher vehicle utilization, cheaper manufacturing costs, higher personalization and better user experience when driving in more dynamic environments (as today's cities are), and of course saving increasingly precious space in urban areas.

5 https://www3.epa.gov/climatechange/ghgemissions/sources/transportation.html
6 https://www.fueleconomy.gov/feg/evtech.shtml
7 http://www.adlittle.com/downloads/tx_adlreports/ADL_Future_of_urban_mobility.pdf
8 http://52.68.60.251/ojs/index.php/ijbi/article/view/28/31

Self-balancing scooters

Self-balancing scooters (Segways) and self-balancing two-wheeled boards ("hover boards") are gaining in popularity.
Drivers of these two-wheeled, self-balancing, battery-powered electric vehicles are treated the same as pedestrians in the majority of cities and can move in the same areas as them (even indoors). They have already been adopted in industrial and fleet applications, where employees are on their feet or moving around a lot, but for personal transportation purposes there are still some problems.[9] When it is not being used, it still requires some sort of parking space, and if your building has no elevator and you have to carry your Segway upstairs its weight is also problematic. So in order for them to be more widely used, the infrastructure that is built for pedestrians should be altered to some extent.[10] There are also some legal issues, as in some countries, the UK for example, Segways are actually illegal to use in public.[11]

Some of the advantages and disadvantages of using self-balancing scooters are listed below:

Pros
- About the same space requirements as a pedestrian
- Very agile

Cons
- Range
- Dependent on weather conditions
- Hard to transport larger luggage
- Requires driver's attention

E-bikes and E-scooters

E-bikes are commonly used as commuting devices in Asia and many western European countries, displacing millions of cars from city roads every year. Western Europe will account for an estimated 1.7 million e-bike sales in 2016.

Germany has recently opened bicycle highways (over 100km) that are, in the estimation of the German Regional Development Group, going to remove 50,000 cars from the road every day, consequently reducing traffic jams and accelerating the transition to cleaner transportation devices.

E-bikes can be powered on demand, but they can also simply assist with pedalling which could enable people with disabilities to also spend their time actively. In the Netherlands, for example, e-bike ownership is especially popular among people aged 65 and older. The e-bike is used in particular for recreational bicycle trips, shopping and errands.

One problem introduced by e-bikes is that they are too fast for the normal bike lanes yet too slow for normal roads. As a result their power output is being artificially limited and some new roads are being built especially for them. Another barrier is the purchase price; they are three times more expensive than a normal bike.[12] Some of the advantages and disadvantages of using e-bikes and e-scooters are listed below:

Pros
- Higher speed than a Segway

Cons
- Dependent on weather conditions (in most cases)
- Hard to transport larger luggage
- Requires driver's attention

Micro-cars

It is generally known that nowadays multi-seater cars are not very well used. According to the National Travel Survey, 61% of car journeys are single occupancy only, and that rises to as high as 86% for commuting journeys by car. Compared to the infrastructure required for the daily rush hour, this represents a phenomenal over-capacity, a high price for the luxury of private travel.

Because cars are such a big one-off purchase, people tend to buy them according to their maximum possible use. For most people, the money saved in buying a one-seater would easily cover the costs of hiring or car-sharing a larger car on those days when a larger one is required.[13] Some of the advantages and disadvantages of using micro-cars are given below:

Pros
- Can transport more luggage than bikes

11 http://www.telegraph.co.uk/technology/news/11926027/Hoverboard-scooters-are-illegal-to-ride-in-public-police-say.html
12 https://en.wikipedia.org/wiki/Electric_bicycle
13 https://makewealthhistory.org/2014/03/14/is-the-car-of-the-future-a-one-seater/

- Higher speed
- Greater comfort
- Greater distances can be covered
- When autonomous, driver's attention not needed

Cons
- Less agile
- More space demanding
- Higher cost

Shared on-demand minibus

A rising interest in comfortable, fast and smart mobility requires a new urban transport approach. Because of the large amount of money spent on frequent taxi rides, and the increased overcrowding and scheduled routes of public transportation, e.g. bus lines and metros, there is a need for a change in the current range of urban mobility.[14] A potential new solution could be offered by the implementation of a shared on-demand minibus with an electric drivetrain.
If an on-demand bus is planned within a city, various types of organization are possible. On the one hand a scheduled minibus with almost fixed routes is feasible. It would replace more and more current public buses which are operating inefficiently with regard to their capacity. The rate of dissatisfaction of passengers is also rising. They are not willing to wait and travel much longer than with alternative individual means of transportation unless either the prices are very low, or the detours, and as a consequence the time of the trip, are decreased. On the other hand a flexible minibus could be implemented which builds its route on the requests of people who need to be transported. In general the level of flexibility depends on the spatial structure of a city. A highly-flexible mobility system in city areas of low population density allows rides to be shared as effectively as possible. As a consequence the on-demand minibuses could be better scheduled if the city region is closely inhabited and common directions of potential passengers can be bundled together more easily.[15]

The target groups for this kind of mobility are various groups of people of different ages and personal conditions. For instance, a group of students with the same destination of the university could be combined in one trip. Furthermore, families would not need their own car anymore because this vehicle could combine the required trips for the different destinations of fathers, mothers and children, from kindergarten to supermarkets to a business location.

The main advantage of an on-demand bus is the higher flexibility of transportation for distances between two and ten kilometres. The shared minibus is available wherever and whenever it is needed and can replace privately-owned cars. Moreover large-capacity public service vehicles, e.g. buses, could be substituted by a smaller on-demand minibus, so the invested capital of cities in public buses, as well as carbon dioxide and noise emissions, could be reduced.

An important precondition of the successful implementation of an on-demand minibus is coherent, broad communication to the target group, as well as a smart and intuitive handling of the system to order, book and pay. The shared on-demand means of transport should be combined effectively with other ones in order to avoid cannibalization effects (where customers are lured away from one mobility offer by another one targeting the same group), otherwise the advantages of an additional shared system cannot be reached. For a region-wide integrated mobility system, other types of individual and public transport should be still part of route combinations.

In the following picture the key characteristics of a potential business model are summarized by the business model CANVAS. These nine parts could be used to organize an on-demand bus from the very beginning.

The "Kutsuplus" bus in Helsinki is a practical example of the implementation of an on-demand vehicle. Although the project failed because of the expanding costs, it was successful when judged by two of its main targets: assessing technological feasibility and generating user acceptance for a shared on-demand bus. The aim was also to reduce privately-owned cars in Finland and match travellers using similar routes. The pricing model was based on one ride and not on the distance. Furthermore the amount of money spent on one trip (5€ in 2014) was between public transport (3€) and taxi (starting 6€).[16]

14 http://www.foerderland.de/digitale-wirtschaft/netzwertig/news/artikel/wegweisendes-experiment-hier-kommt-kutsuplus-der-smarte-on-demand-bus/
15 German Federal Ministry for Transportation, City Development and Construction: Mobility in times of demographics, 2012, p. 64
16 http://citiscope.org/story/2016/why-helsinkis-innovative-demand-bus-service-failed

A still existing and even growing shared on-demand minibus system has been created by "BRID" for a new urban infrastructure which makes it much easier to move around the city. This product focuses on providing more efficient urban mass transit in Boston, Washington DC, and Kansas City, which is twice as quick, at about the same cost, as public transport. They optimize pick-ups, drop-offs, and routing based on demand, meaning a 40-60% more efficient trip (on average) than traditional transit at a $2 to $6 price point.[17] A further positive sign for the future potential of on-demand minibuses is the fact that FORD is now investing in BRID to be part of that trend as well.[18]

All in all a shared on-demand electric minibus bundles a lot of advantages by transporting people faster and being more flexible and more cost-efficient than existing mass transits or trips with privately-owned cars.[19]

Non-motorized transportation

Even though the concept of pedestrian zones is not new, a lot of cities like New York are closing more areas to vehicle traffic and implementing other pedestrian-friendly changes. Another goal of many cities is to make cycling safer, easier and more popular. Bike-sharing systems have proliferated – more than 70 are in place across the United States – and some large cities are setting aside more of their roadways for cyclists. Cities are in general keener on encouraging people to move and enhancing health and sustainability in their citizens. But to do this they must properly incentivize people to walk and cycle, and provide the required infrastructure to ensure the safety and efficiency of non-motorized transport options.

Walking and cycling can be a very efficient and fast option for people, particularly for the first and last mile of a trip. As traffic-calmed sectors are expanding, an increasing number of people will no longer be able to reach their homes by car or bus. This is where a well-developed cycling and pedestrian infrastructure comes to the fore, facilitating people to reach their final destination. In addition to that, it would be possible to add some other sustainable and slow-moving vehicles to this infrastructure, such as Segways. Currently, the maximum range that people want to walk to reach their destination or next mode of transport on average in Europe is around 600 metres.[20] Cities can try to increase this by making walking more attractive, e.g. by making pedestrian zones greener, or by installing better lighting, special pedestrian street signs or using better paving materials.[21]

Adding electric bicycles to bike-sharing fleets can be an option to incentivize more people to use the service, and this also extends the distance people are willing to cycle; this would be a great benefit, especially for elderly people. When people are convinced that non-motorized mobility options can be faster than motorized forms of transport like buses or cars, they will be more willing to use this transport option.

According to a study carried out by MC Kinsey in 2015, "A ten-mile commute by car takes about 30 minutes door to door. By bicycle that would take about 60 minutes; by e-bike, though, it would be only 35 minutes, which makes it an attractive option. Getting employees to bike to work is worth real money; each parking space that can be saved on corporate campuses is worth $10,000 to $20,000. [22]

Apart from all the positive effects of increased and improved non-motorized mobility use, there are some limitations which have to be considered, such as bad weather, personal fitness and luggage.

Walking and cycling may be attractive options for many people as long as there is good weather, but this changes dramatically when temperatures are below zero, when it is raining, and also when it is extremely hot. Furthermore, some people may not be in good enough physical condition to ride a bike or walk longer distances, especially if they are injured or old. With regard to tourists and business travellers, luggage might also be an issue for mobility routes which include a long walk or cycle. So to sum up, non-motorized

17 http://www.bridj.com/#how
18 http://fortune.com/2016/02/11/ford-on-demand-bus-service/
19 German federal ministry of transportation, city development and construction: Manual for flexible planning in public transportation, 2009
20 »basics: walking distance to transit", April 24, 2011, http:/ humantransit.org/2011/04/basics-walking-distance-to-transit html
21 September 2015, McKinsey & Company, "Urban Mobility at atipping point"
22 September 2015, McKinsey & Company, "Urban Mobility at a tipping point"

transportation options are a growing part of the mobility ecosystem which should be considered when planning infrastructure and mobility systems, but the availability of alternatives should be assured in order to guarantee a fitting mobility solution for users in any situation.

KEY PARTNERS:

- Public transportation organisations
- Taxis centers
- Payment processors
- Map providers
- Investors
- Public institutions (e.g. university, school, kindergarden, etc.)
- Companies
- Shops
- Restaurants

KEY RESOURCES:

- Trained drivers
- Intelligent route matching system
- Application for integrated mobility

KEY ACTIVITIES:

- Route matching
- Marketing and promotion of new mobility offer
- Hiring,drivers and initial training
- Managing shifts and payments of drivers
- Customer support
- Customer and Transport data storage, preparation, analysis, evaluation

COST STRUCTURE:

- Launch events and marketing
- Purchase and implementation of minibuses
- Salaries to data analysts, customer supporters, drivers, application engineers
- Technological infrastructure for sensors
- (C2C, C2I communication)

CHANNELS:

- Mobility app for Android and iOS
- Website
- Call the bus

REVENUE STREAM:

- Pay per ride or pay per km depends on target group)
- Flexible (monthly) subscription
- Fixed prices for some fixed routes
- Surge pricing for flexible routes
- Basic service: ride on its own
- Premium package options with drinks, snacks,newspaper, installed tablets, pick up from home,
- XL seats etc.

- **CUSTOMER RELATIONSHIP:**

- Personalized application to preselect preferred transportation means
- Customer support
- Rating System for service and drivers
- Bonus system and discounts for user motivation

VALUE PROPOSITION:

Customers:

- Additional option of transportation
- More comfort than public transport
- Cheaper than own car/taxi
- Minimum waiting time
- Cashless ride
- Track the minibus in real time
- Booking days or minutes in advance

Mobility as a Service (MaaS)

The aforementioned solutions are vehicle-based. The future is going to be about shared, digital and cost-efficient options. That is the reason why people are beginning to prefer mobility as a service and not as an asset-fixed way of moving around. The general trend of sharing instead of owning cars affects the development of the mobility sector. As a consequence the demand for a smart combination of different mobility options to improve route planning is increasing.

Smart. Green.
Mobility for Everyone in LJUBLJANA

1. Enter your end location
2. Application chooses best transport options based on individual preferences
3. Combinations of types of transportation, routes, hubs, distances, price, time
4. Cashless Payment
5. Waiting time until pick up
6. Evaluation of the journey

Use Cases

In the following sections examples of use cases for special target groups are explained in detail. The key message is the use of the new integrated mobility app for Ljubljana "MoveLJ" in the future.

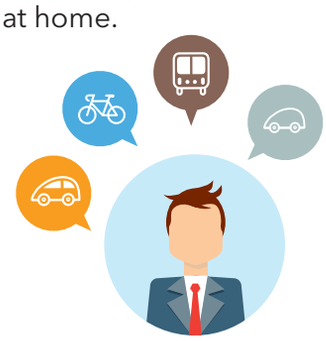
Students

A student and his colleagues want to go from their dorms to the university, which is in the city's middle ring. He opens the MoveLJ on his phone and sets his profile preferences to low cost/any time, also specifying that there are five passengers. He enters the address of the university. MoveLJ finds him and his friends an on-demand bus with 8 seats, which will pick them up 100m away, shows them the directions to the starting point on the map, and also shows them the route which the bus will be taking and a timer near the map pin, which counts down the time until their bus arrives. He considers the price of the trip with his friends and confirms it. The money is immediately subtracted from his credit, and a notification is sent to the bus driver to come and pick them up.
In the case of him declining that trip, MoveLJ offers him the next three calculated routes that most closely match his preferences. If they miss their bus, the money is refunded and MoveLJ calculates a new route for their trip.
They follow the directions to the pick-up spot and the bus arrives to pick them up. When they arrive at their destination, MoveLJ asks them to rate their trip. The student then wants to go to the city centre. Since the weather is nice, MoveLJ suggests a shared bike. He then returns to his dorm on the same bike and leaves it at a station nearby.

Families

A family with two children lives in Ljubljana's middle ring. The mother and father both work at Comtrade. When they use MoveLJ, it knows they have two kids. It suggests that they take an on-demand minibus to get the children to the kindergarten. They accept and the payment is

deducted from their credit. When they arrive at the kindergarten, MoveLJ suggests that they take the same minibus to work, but they have their preferences set to bicycles, so it routes them to a nearby bike hub, where the bus drops them off. They then take shared bicycles to get to work. After work, they are tired so MoveLJ suggests an on-demand bus straight from work to the kindergarten where they pick up the children and then get dropped off at home.



Business people

A businessman is coming from Domžale to work in Ljubljana. Before he leaves home, he opens up MoveLJ to see the best transport options. His preferences are set to fast/any cost. It suggests that he takes an on-demand bus to Ljubljana's outer ring, which has a hub for electric vehicles. MoveLJ shows him that there will be ten available one-person electric cars, and it also knows that there is a charging station near his workplace, so it suggests this option. He accepts the offer, and the money for the e-car rental as well as the parking is deducted from his credits. He arrives at work and leaves the car at a charging station nearby. He then goes to the gym, and since he will be going from the gym to the city centre, MoveLJ suggests a shared bike. When he goes home, he cycles to an e-car hub and takes an e-car back to the hub he first arrived at, where a micro car picks him up and takes him home.

Conclusion

The presented improvements in the current mobility system makes consumers the biggest winners. They will have more ways to get around cheaper, faster and with customized levels of service and convenience. Furthermore, collaboration will become essential in the new mobility economy. Mobility services will need to find partners to provide the technology to power their businesses. Manufacturers will need to work with insurance companies to develop new products for autonomous vehicles, and there are times when competitors will also find it necessary to collaborate, as Lyft and Uber do when dealing with regulators. [23]

Based on the project results urban mobility will be more on-demand, with more sharing, and will provide a broader spectrum of services. Autonomous vehicles may be feasible, in both technical and regulatory terms, and faster than commonly expected for certain trip types. Furthermore urban transit will likely be lower cost, faster, and safer, and the lines between private and public transport will be increasingly blurred.

For the reasons mentioned in chapter two, cities have to change their current mobility situation to be more efficient and sustainable with regard to the future of urban areas. The presented solution is one option for cities to make their communities more livable and sustainable. It must be considered that this type of solution is aimed at being implemented in around ten years time, and after that there will be continuous need for further improvement in the urban mobility situation. This further improvement will depend on the established technologies which will be available in the future.

23 McKinsey&Company (2015): Urban mobility at a tipping point

Outlook

This project has focused on advancing the mobility ecosystem with the help of innovative technologies, and specifically predictive analytics, to achieve a vision for mobility in the near future. But there are visions for mobility after 2025 which are probable on the basis of further advancement of technologies and a changed mindset of people. In this scenario, a city would be without traffic noise and safe for pedestrians and cyclists. There would be autonomous specific-purpose vehicles which would predict the movements and trips of people and adapt their route accordingly. The average speed of vehicles would be reduced to 30-40km/h, but due to the absence of traffic lights and the ubiquitousness of car-to-car communication, they would be able to move steadily, shortening the total trip time despite the reduced speed. The vehicles would independently charge themselves when their battery level reaches a critical level. There would be underground charging areas with wireless charging possibilities where electric buses, cars and other vehicles could recharge their batteries. Transportation would not only be limited to the ground surface, but would also expand to aerial routes with elevated railways and other fast track vehicles which would be on a driveway above the city. Because autonomous vehicles and shuttles would constantly be moving, they would not need any parking space other than the charging facilities, which would make it possible to have wider pavements and more green spaces within the city. Above the charging garages, there would be central transportation hubs which would enable passengers to change modes of transport quickly and conveniently. Besides those specific purpose and fast track vehicles, people would be able to use bicycles, e-bicycles and Segways as required. Due to the increased usage of non-motorized vehicles, general wellbeing and health would be better. People would have a single point of access to the system through an app which would be integrated with special transport bracelets, recording the use of mobility modes to enable individual payment depending on usage. Furthermore, the users would be provided with a frequent overview about the different modes of transport they have been using, their level of fitness and current ability to pay. The whole system would be supported by a gamification concept which would challenge users to try new modes of transport and help them to use the most efficient route depending on real-time information.

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