# Digital door-to-door solutions

### 10 Guiding principles for railways

**UIC**

INTERNATIONAL UNION
OF RAILWAYS

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# DIGITAL DOOR-TO-DOOR SOLUTIONS
## 10 guiding principles for railways

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# OVERVIEW

Technological advancements in the field of digitisation and internet services are profoundly changing all areas of human society, it is changing our economy, our society and the relationship between the individual and the world around them.

This technological transformation is already deeply affecting today's transport systems and is bringing a **new mobility paradigm** able of guaranteeing more accessibility, better management of public space and greater environmental sustainability. Smart mobility will improve the outcomes and reduce negative effects from transport, addressing several complicating factors in the meantime.

**Rail travel and public transport** must play a crucial role in this new paradigm as the backbone of an integrated shared mobility system. Rail and public transport are the most sustainable modes of transportation, for both urban and non-urban travel addressing crippling congestion, road safety and air quality.

Just as the steam engine was central to the first industrial revolution, railways can be a driver

in this fourth industrial revolution of digitalisation. This digital revolution is changing mobility trends, passenger expectations, and expanding the range of services available to users and railways can both benefit and lead this change. **Digital door-to-door solutions** are effective tools to make rail transport more attractive, acting on one of its main weaknesses: the need for other means of transport to achieve the so-called first and last mile of a train journey.

These new services first bring **greater integration** between rail and other transport modes (shared and non-motorised ones), a factor that improves the physical continuity of the journey when you move from one means of transport to another. The door-to-door solution improves the **intermodality** of train journeys and incentivises users to take a **multimodal approach** for their journey. The full integration is realised by **MaaS platforms** (Mobility as a Service), able to systematise the various door-to-door services, providing for example an intermodal journey planner, a booking system, a single payment method, real-time information, allowing customers to buy mobility services provided by the same or even different operators.

Digital door-to-door services can exponentially increase the quantity and quality of **information exchanged** between railway operators and passengers. Information and data flow enable the interaction between passengers and the physical intermodal services available at railway stations. At every stage of the journey, door-to-door digital rail services can make it easier for passengers to combine train travel with the use of facilities such as bike parking, EV charging points, and car-sharing systems, allowing users to book, pay, and check availability.

From an environmental point of view, the qualifying objective is that, thanks to door-to-door solutions, railways can **gain greater market share** compared to less sustainable modes such as road and air travel, and overall can improve the services offered to their customers. MaaS platforms are a major part of the transformation change needed to make rail the backbone of a sustainable mobility system.

Railways play an important role in **reducing the overall impact of the transport sector**:

by committing to reducing their own environmental impact and by taking the opportunities offered by digitisation to promote a multimodal approach and to improving the intermodality of transport systems. Both necessary conditions to see an increase in the share of rail transport at the expense of less environmentally friendly alternatives.

Railway companies can "surf" the wave of door-to-door services placing themselves at the center of sustainable mobility, particularly in cities, starting up new projects, and planning new services. Railway stations can help this process by becoming a **"mobility hub"**.

# GUIDING PRINCIPLES  FOR  RAILWAYS

### 1. TAKE A LEADING ROLE
The mobility service market is experiencing a rapid transformation, with door-to-door and seamless mobility solutions. Railway companies should take the opportunity and lead this new transport landscape.

### 2. PROMOTE AN OPEN, FAIR AND EQUITABLE DIGITAL ECOSYSTEM
The sharing of data and sharing of common rules need trust and cooperation as two pillars of the system. Railway companies can act proactively and become a key driver by outlining and modeling this approach.

### 3. COLLABORATE WITH PUBLIC AUTHORITIES
Railways are in the position of partnering with public authorities, sharing information and digital tools, while together effectively promoting sustainable transport choices to the public.

### 4. LEVERAGE DIGITAL TECHNOLOGY
Railways have the opportunity to benefit from the role of digital intermediary; matching passengers with information, products, and better data to create value for their customers.

### 5. TARGET DOOR-TO-DOOR SOLUTIONS CONSISTENT WITH YOUR BUSINESS STRATEGY
There is no 'one size fits all', railway companies should make strategic partnerships with other mobility solutions that make sense for their business, customer and context.  Strategic partnerships must have specific and achievable objectives capable of increasing the competitive advantage of both companies.

## 6. SET OUT BUSINESS PARTNERSHIPS WITH A FAIR AND COLLABORATIVE CULTURE

An aggressive strategy of dealing with other mobility providers, based on railway company's incumbent role, risks being counterproductive; creating a collaborative culture will help make investments in new technologies and new processes more successful.

## 7. TRACK AND ANALYSE MOBILITY DEMAND

Invest in digital solutions that aim to analyse travel behavior of current and potential railway customers. Use that information to improve the service and offering to all customer needs and attract new customers.

## 8. CREATE USEFUL INTERACTION BETWEEN PHYSICAL AND DIGITAL ACCESSIBILITY

Railway stations are the new hub of urban shared mobility:  digital solutions, can offer new analysis tools to guide choices for users and improve station design.

## 9. MAKE SURE THE DIGITISATION PROCESS IS INCLUSIVE

The digital transformation of railways should not exacerbate inequalities, between central and suburban areas, between cities and non-urban areas, between people with higher and lower technological skills and access and between the youth and elders.
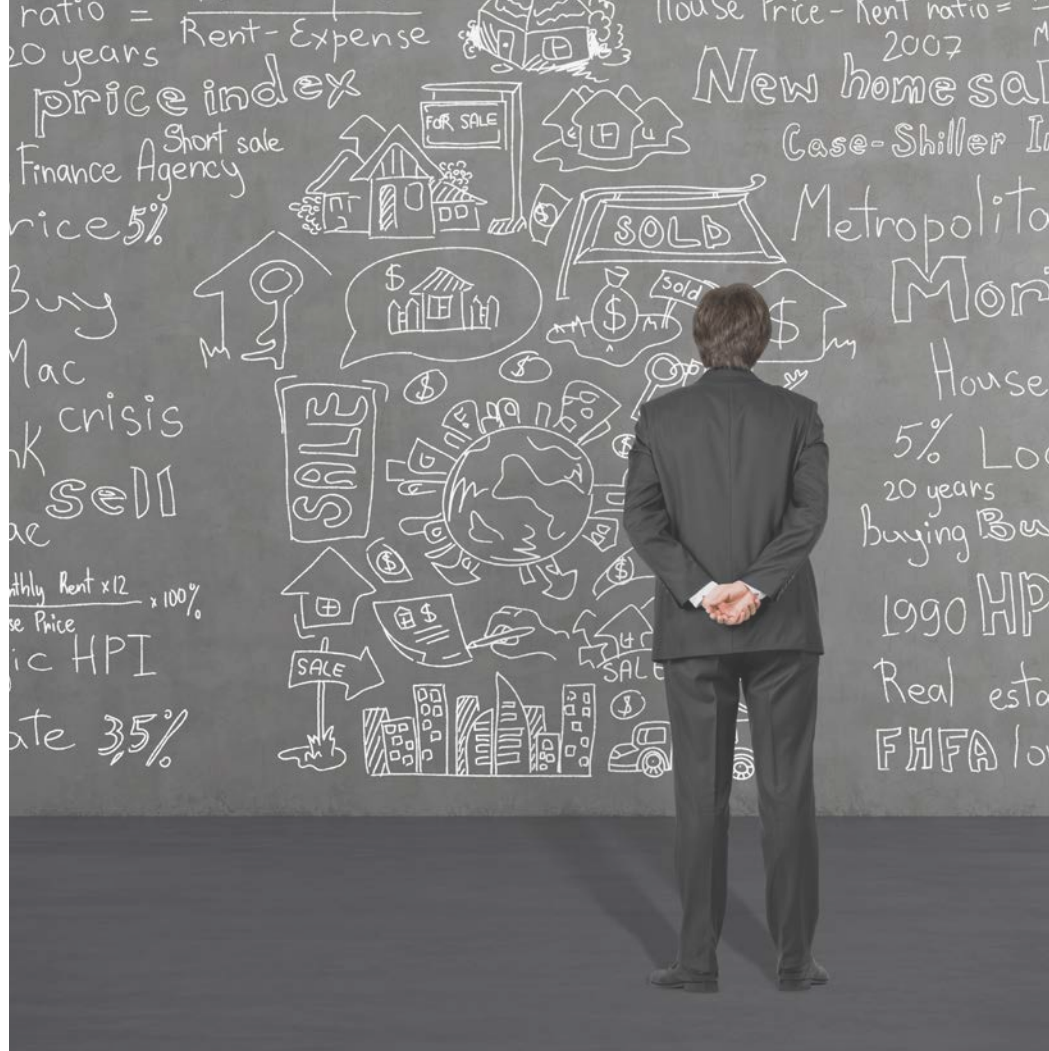
## 10. PROTECT DATA

Data has become a crucial corporate asset, and data protection has turned into a topic of strategic interest.  Put in place robust governance to protect your data and the data of your partners.

# 1

## FRAMEWORK

# The "Age of the algorithm"

**Digital transformation is one of the greatest challenges** that every sector of society, the economy, government, organisation, industry, and even every single individual must face today. The coronavirus pandemic has further strengthened the central role of algorithms in the everyday life of billions of people around the world. **Digitisation is reshaping economies, connecting people, promising to generate more productivity, lowering costs and resulting in more efficiency.**

Digitalisation can contribute positively to people's lives and helps people make more informed choices. Digital technologies are seeing a rapid uptake in many sectors including science, healthcare, finance, marketing and advertising and, of course, transport. In these sectors, algorithms and AI (Artificial Intelligence) systems can work on big volumes of data and complex models to generate better resource allocations and improve decision-making.

A small number of large players in the digital and internet sector have completely changed the face of the global market. In the US in 2001, only one of the world's top five largest corporations was a technology company (Microsoft). Today, the top five is made up entirely of technological giants.

In this **"Age of the algorithm"**, algorithmic governance, as a concept, has emerged and is studied to understand the role of algorithms and their impact on the social order.

Digital technology and algorithmic systems are neither "weapons of math destruction" (O'Neil, 2016) nor simple, benign tools of mass convenience. They are neutral technology-based systems – tools. Their impact depends on how they are used and how they are regulated.

**Market capitalisation of the top 5 technology companies (in billion dollars)**
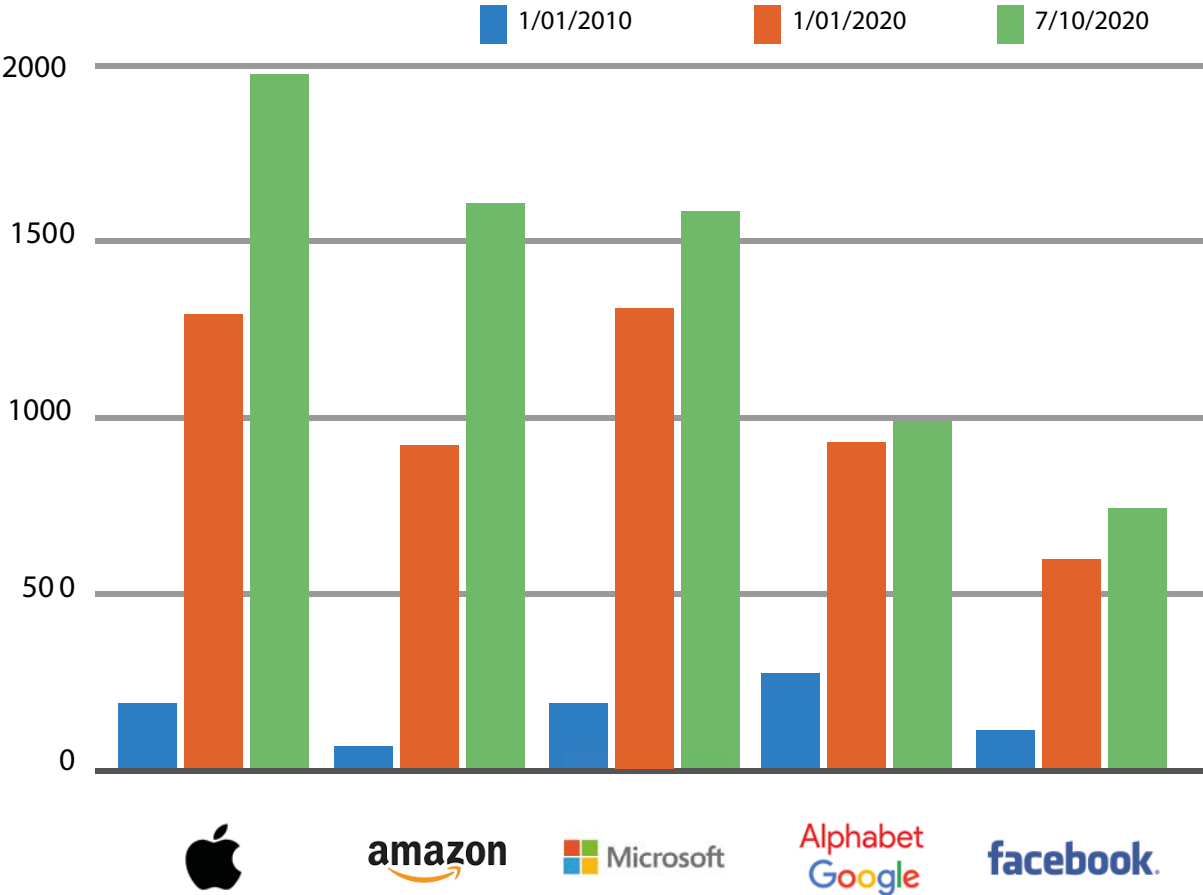


Source: Statista

# Smart
# Mobility

Connectivity, mobile computing devices, and new digitally enabled mobility services are the key elements of new business models that are changing how people travel. A more seamless, digital and automated mobility is growing to dominate urban and non-urban travel in the future. There is much debate about scenarios, goals, and next steps, but what seems clear is that the future of transport will be deeply impacted by digitisation.

The endpoint is **Smart Mobility**, a new kind of mobility that guarantees accessibility, public space management and environmental sustainability through digital technologies.

It expands on the Intelligent Transport Systems concept - which weaves digital technologies amongst devices, vehicles, and infrastructure - to focus more on communication assets and mobility data platforms.

**Smart Mobility seeks a paradigm shift** and tends toward a multimodal transport system with high flexibility and convenience, based on intelligent management platforms, known as Mobility-as-a-service. Railway and public transport systems play a crucial role in this new paradigm, transforming to become the backbone of any integrated shared mobility system as the most sustainable modes of mass transportation, for both urban and non-urban travel.

Is it hoped that most people will eventually prefer being users of public transport, more so than being car owners, and railways can ride this trend through the development of door-to-door solutions.

The various components of smart mobility have the potential to improve mobility outcomes and reduce negative externalities related to transport activity, but also a number of complicating factors will have to be addressed and managed.

# Focus

## The European strategy for sustainable and smart mobility

Smart mobility is not actually a goal but a tool in the hands of governments and public authorities, which have the responsibility of defining objectives and strategies for sustainable development.

In December 2020, the European Commission published the "**Sustainable and Smart Mobility Strategy** – putting European transport on track for the future".

The strategy sets clear and urgent objectives, "we must shift the existing paradigm of incremental change to fundamental transformation" aimed at sustainable, intelligent, and resilient mobility, in line with the Green New Deal objectives of transport sector decarbonisation (-90% of GHG by 2050).

Europe is defining how the mobility sector will be in the next 30 years, a sector that will grow as a part of the post-pandemic economic recovery, but in a way that is more sustainable and environmentally friendly. It should be based on an efficient and interconnected multimodal transport system for both passengers and freight, enhanced by an affordable high-speed rail network, infrastructures for electric mobility solutions, and an urban environment that fosters active mobility. From this point of view, the European strategy believes that digital solutions are necessary to bring the whole system up to date, which will also be able to make its impact more widespread and efficient.

Therefore, the Commission's strategy identifies three pillars for its future initiatives:

1. make all transport modes more sustainable;
2. make sustainable alternatives widely available in a multimodal transport system;
3. put in place the right incentives to drive the transition.

Highlighting all the policy levers to achieve the set objectives:

- significantly reduce the current dependence on fossil fuels;
- decisive action to shift more activity towards more sustainable transport modes (in particular rail, public transport, and active modes of transport);
- Internalisation of external costs with the application of the "polluter pays" and "user pays" principles.

# 2

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# The role of railways and digital door-to-door solutions

# Definition and areas of intervention

Railways can benefit from this digital revolution that is changing mobility trends and passenger expectations, and expanding the range of services available to users.

Digital door-to-door solutions are effective tools to make rail transport more attractive, acting on one of its main weaknesses: the need for other means of transport to achieve the so-called first and last mile of a train journey.

These new services first bring greater integration between the train and other transport modes (in particular shared and non-motorised ones), a factor that improves the physical continuity of the journey when you move from one mean of transport to another.

A digital door-to-door solution improves the intermodality of train journeys and encourages users to take a multimodal approach for their mobility needs.

Digital door-to-door services will revolutionise the concept of ticketing, exponentially increase the quantity and quality of information that can be exchanged between railway operators and passengers (with benefits for both), and allow users to interact with several services available in railway stations.

Here below are the main areas of intervention that railways can focus on in the field of digital door-to-door solutions.

**The seamless connection between passengers and railway operator** - the seamless conection between passengers and railway operators concerns the flow of information. Passengers will come to expect and demand instant and real time service information (before, during, and after their journey, especially when there is disruption). A seamless connection also enables the interaction between passengers and the physical intermodal services available at railway stations. At every stage of the journey, door-to-door digital rail services can make it easier for passengers to combine train travel with the use of facilities such as bike parking, EV charging points, car-sharing systems, mobility assistance, and perhaps even shared working and meeting spaces. Passengers will wish to be able to book, pay, and check availability for them all.
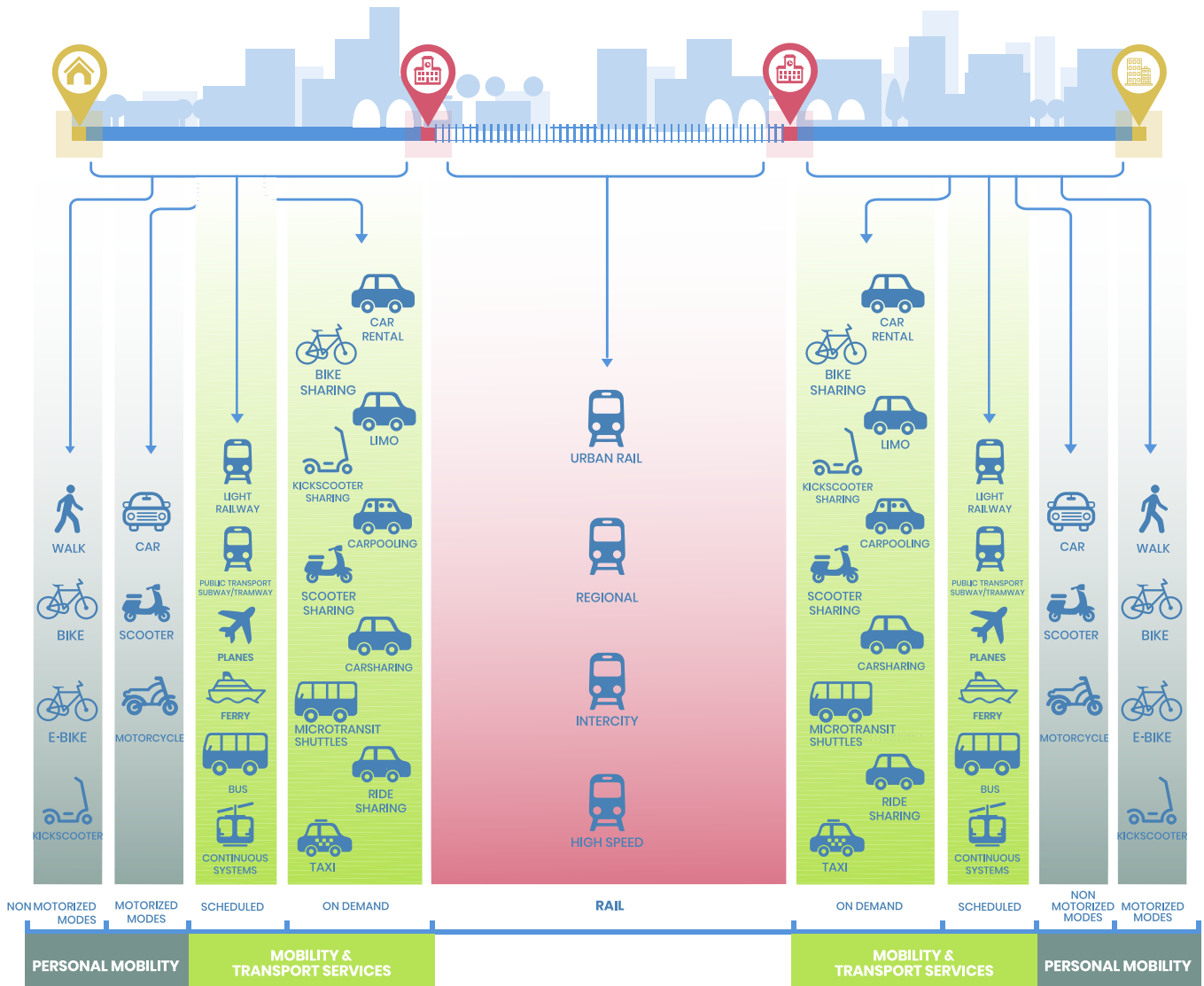
**Journey planner** - Journey planning platforms are the next step to make mobility solutions more consistent with consumer's needs. It consists of gathering digital data about different transport modes and organising them into a smart source of information useful to plan multimodal door-to-door journeys. Journey planners enable users to plan multimodal journeys according to their habits and preferences, which concern modal preference, price, duration and environmental impact. Journey planners may play a crucial role because they can trigger the use of more sustainable modes for the first and last mile.

**Ticketing** – The digitisation of ticketing operations makes it possible for users to make integrated payments for multiple travel solutions through a single process and with a single transaction, which is very important for intermodal travel solutions. Bundles or pay-as-you-go tickets are different ticketing services that can be implemented as further developments in the integration of services (MaaS for example), and if necessary tailored to each customer segment or individual user.
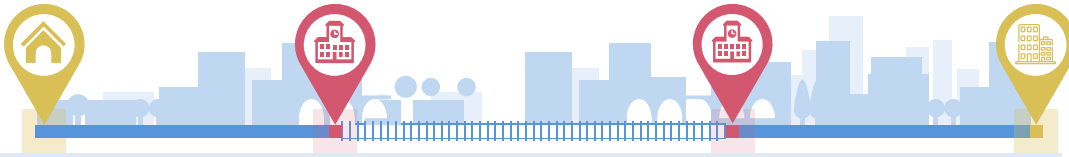
**Data tracking** - new digital tools make it possible to know and analyse the user's mobility preferences, which as a result would allow service providers to improve all aspects of the experience. The acquisition, selection, and tracking of integrated movements and customer feedback are essential to feed predictive algorithms, profile users, and continuously adapt mobility services to customer needs.

MaaS platforms (Mobility as a Service) realise full integration between different mobility services.

WALK
CAR
LIGHT RAILWAY
PUBLIC TRANSPORT SUBWAY/TRAMWAY
PLANES
FERRY
BUS
CONTINUOUS SYSTEMS
BIKE
SCOOTER
MOTORCYCLE
E-BIKE
KICKSCOOTER

CAR RENTAL
BIKE SHARING
LIMO
KICKSCOOTER SHARING
CARPOOLING
SCOOTER SHARING
CARSHARING
MICROTRANSIT SHUTTLES
RIDE SHARING
TAXI

URBAN RAIL
REGIONAL
INTERCITY
HIGH SPEED

NON MOTORIZED MODES
MOTORIZED MODES
SCHEDULED
ON DEMAND
RAIL
ON DEMAND
SCHEDULED
NON MOTORIZED MODES
MOTORIZED MODES

PERSONAL MOBILITY
MOBILITY & TRANSPORT SERVICES
MOBILITY & TRANSPORT SERVICES
PERSONAL MOBILITY

# DOOR-TO-DOOR SOLUTIONS

# Areas of intervention of door-to-door digital solutions

| SINGLE JOURNEY SOLUTIONS | | | | |
|---|---|---|---|---|
| | Journey planning | Planning the journey O/stA | Planning the journey stA/stB | Planning the journey stB/D |
| | Ticketing | Buying the ticket/rental vehicle | Buying the ticket at the ticket office | Buying the ticket/rental vehicle |
| | Facilities | Check availability on site and use | Check availability and use on board trains and in railway stations | Check availability on site and use |
| | Information | Search for information on the route to be traveled | Search for information on board the train | Search for information on the route to be traveled |
| | Data tracking | No data produced | No data produced | No data produced |

| SINGLE JOURNEY DIGITAL SOLUTIONS | | | | |
|---|---|---|---|---|
| | Journey planning | Digital platform to plan journey O/stA | Digital platform to plan journey stA/stB | Digital platform to plan journey stB/D |
| | Ticketing | Digital payment systems and shared mobility platforms | Digital payment systems | Digital payment systems and shared mobility platforms |
| | Facilities | Check availability and online booking | Check availability and online booking | Check availability and online booking |
| | Information | Search for information online on the route to be traveled | Information on-line and on board the train | Search for information online on the route to be traveled |
| | Data tracking | Real-time data production during the journey O/stA | Real-time data production during the journey stA/stB | Real-time data production during the journey stB/D |

| DOOR-TO-DOOR DIGITAL SOLUTIONS | | |
|---|---|---|
| | Journey planning | Single journey planning O/D |
| | Ticketing | Single ticketing transaction for the entire journey O/D |
| | Facilities | Single check of availability and booking |
| | Information | Availability of real-time information during the entire journey O/D |
| | Data tracking | Real-time data exchange during the entire journey O/D |

These platforms are able to systematise the various door-to-door services, providing for example an intermodal journey planner, a booking system, a single payment method and real-time information, and they allow consumers to buy mobility services provided by the same or even different operators.

Thanks to the adoption of door-to-door solutions, railways can improve the services offered to their customers and as a result gain greater market share compared to less sustainable modes of transport such as road and air travel.

# Objectives
## Creating multi-modal hubs for modal shift

The importance of physical integration through the transformation of railway stations into hubs of urban mobility should not be underestimated. Railway stations should be an important asset to increasing the volume of passengers by offering easy access and seamless exchanges between different modes of transport, becoming a reference point for intermodal urban mobility. There is a need for actions to be taken that will increase the attractiveness of stations by improving their accessibility, and that will push more and more users to choose the train for extra-urban mobility combined with both active and shared solutions for the first and last mile.
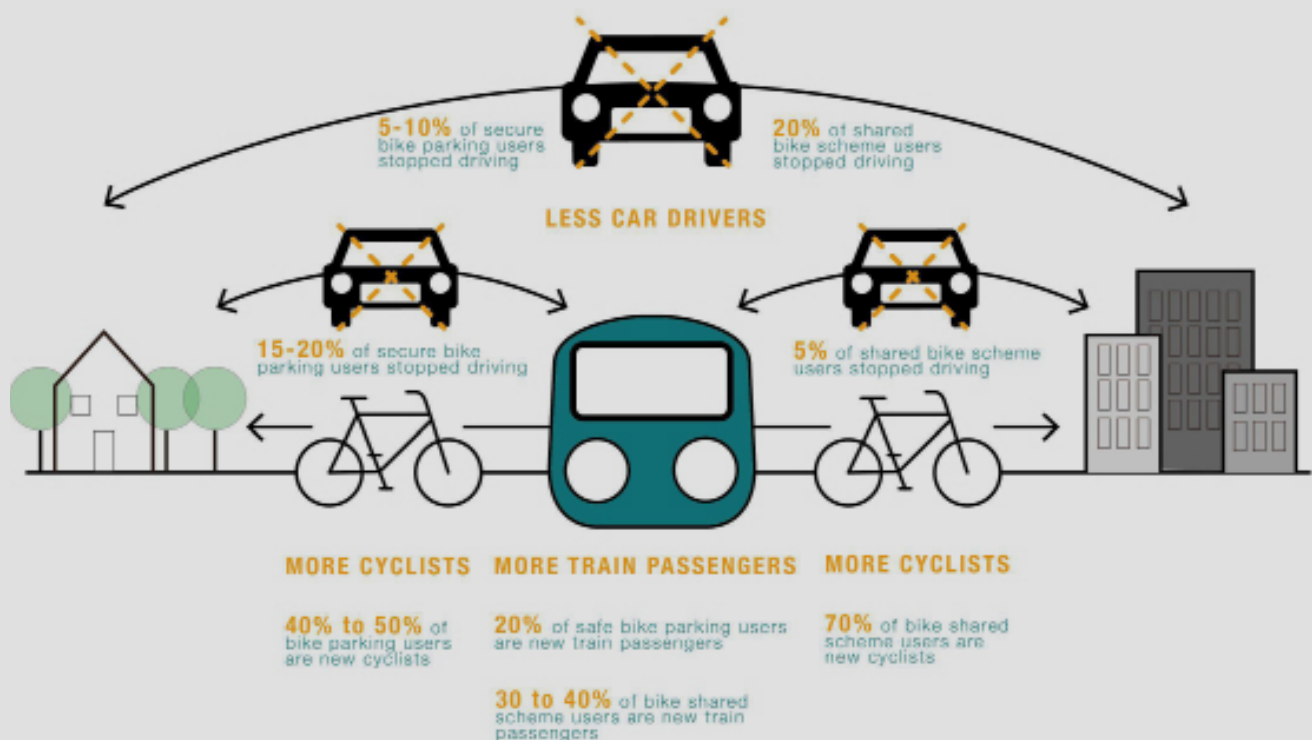
# Case study

## Results from the EU Project "BiTiBi - Easy and energy efficient from door-to-door Bike+Train+Bike

BiTiBi services used the Dutch model as inspiration in promoting the bike-train-bike modal merger over cars and the combination of cars and trains. The project aimed to replicate the Dutch system and to solve the typical issues such as lack of parking for bikes at stations; no last mile solution when taking the train, ineffective integration, etc.

BiTiBi expected to substitute journeys by car with bike-train-bike transport and to increase the modal share of the bicycle for the first and last mile of train journeys in the pilot projects by 2017 - and in the EU by 2020.
PROJECT LINK

5-10% of secure bike parking users stopped driving

20% of shared bike scheme users stopped driving

**LESS CAR DRIVERS**

15-20% of secure bike parking users stopped driving

5% of shared bike scheme users stopped driving

MORE CYCLISTS · MORE TRAIN PASSENGERS · MORE CYCLISTS

40% to 50% of bike parking users are new cyclists

20% of safe bike parking users are new train passengers

70% of bike shared scheme users are new cyclists

30 to 40% of bike shared scheme users are new train passengers

# Reducing emissions, congestion, and accidents

The transport sector is responsible for 24% of greenhouse gas emissions, and this has been an increasing trend with a 17% increase between 2010 and 2019. Three-quarters of transport GHG emissions derive from road transport and from the growth of aviation and navigation. Railways are the most energy-efficient mode of mass transport, with a modal share of passengers and freight respectively of 9% and 7%, compared to only 3% of transport sector total energy consumption (Source of data: IEA, Tracking Transport 2020). Rail has been the only mass mode to have reduced its emissions[1]. Railways must play an important role in reducing the overall impact of the transport sector. Since the transport sector is a primary source of greenhouse gas emissions, ambitious goals to improve it are a priority to meet the objectives of the Paris agreement. The current land transport system,

based mainly on the use of cars powered by fossil fuels, generates unsustainable social, environmental, and economic impacts, especially within urban areas. The people who live in the city are in fact more exposed to air pollution, noise, traffic and accidents, with strong repercussions on their quality of life. It is necessary to achieve a real paradigm shift, making the mobility of people and goods low-carbon, socially inclusive and efficient in the use of resources.

From this point of view, the modal shift to rail has multiple positive impacts, considering that the energy consumption and CO2 emissions per passenger are substantially lower than those of other modes of transport. Most urban and non urban mobility services should move towards the railway system (and mass transport with electric traction in general), and door-to-door solutions offer important solutions for this purpose.

GHG intensity of passenger transport modes, 2019
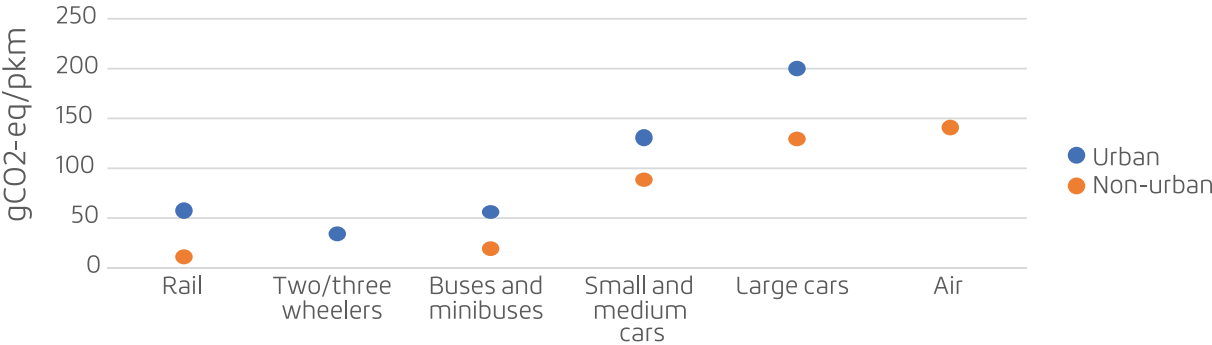


Source: SUSDEF elaboration on Eurostat data, CNIT

**1** https://tcc-gsr.com/transport-demand/transport-emissions/

# 3

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# KEY ELEMENTS

# User-centric mobility

The digital revolution applied to the transport sector is producing a substantial change of perspective, in particular, because attention is shifting more and more from the "means of transport" to the "passenger". There is a new digital demand for mobility, with a multi-modal approach, relying on a much wider range of available options. The digital user market share will continue to grow even more in the coming years, as well as the advent of new digital solutions capable of connecting these solutions in an intermodal key (MaaS platforms for example).

The reason for this change is a result of digital services and tools allowing users to "navigate" through the mobility services on offer and being able to make different choices that meet their needs each time (e.g. travel time), economic needs (cost), social (carbon footprint), recreational (sharing a ride with other passengers), and others.

Railways, like all mobility operators, must be able to recognise changes in their target market, and then work to provide services that match the new needs of passengers.

From this point of view, door-to-door solutions give the opportunity, through a customer-oriented approach, to improve and complete the train travel experience in its three main phases: the start of the journey (planning of the route, solution comparison, etc.), the journey (booking, payment, real-time information, etc.), the end of the journey (customer support, administration, positive feedback and suggestions, complaints management, etc.).
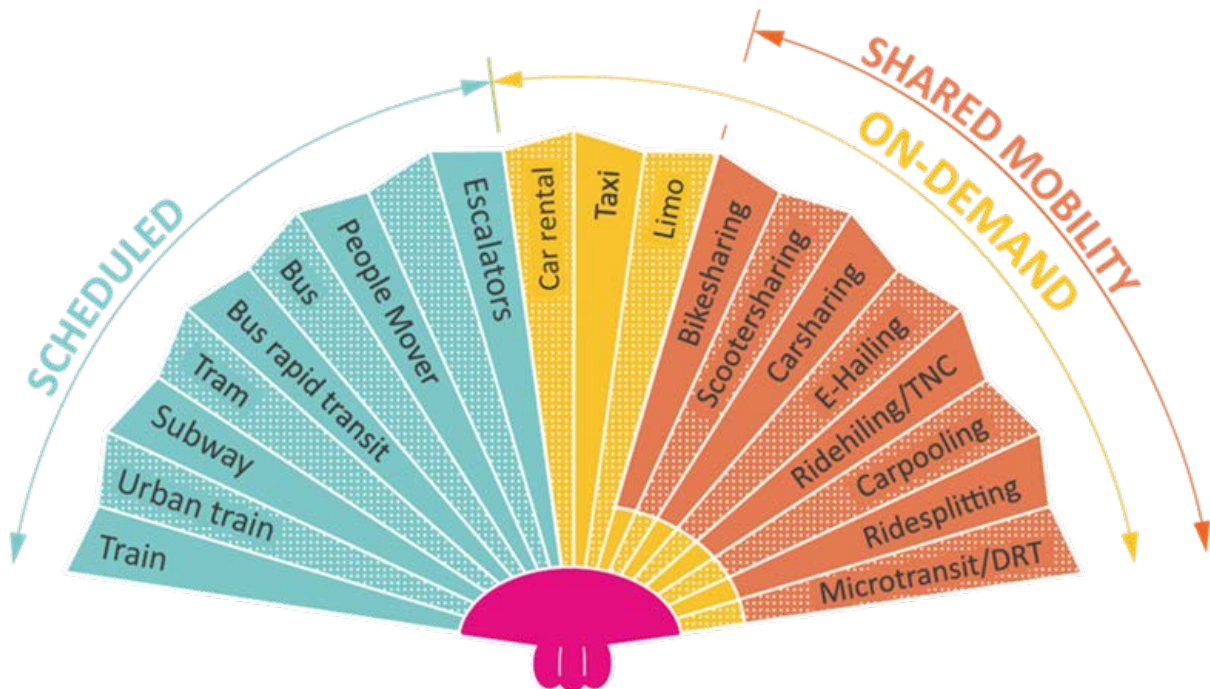
# Shared mobility

Trains, urban transit, and taxis were the first shared mobility services to emerge in the 19th century, thanks in particular to the technological advances of the industrial revolution and the effects of the latter on urbanisation and the economy.

In our modern times, the range of shared mobility services has further expanded and so-called "traditional" services are flanked by

"new" shared mobility services such as scooter or bike sharing, car sharing, carpooling, all enabled by the use of digital platforms.

Today, the train is part of a larger family of shared services that are more integrated with each other and potentially recognisable as a single alternative mobility service to the use of a private vehicle.

**The shared mobility "FAN"**

# Intermodality and seamless mobility

The number of innovative shared mobility services is growing and the performance of new services is complementary to those of traditional services. This creates new opportunities for integration, particularly in the context of the digital revolution to improve the overall quality of trips that combine multiple transport modes to move from door to door (intermodality).

The level of intermodality depends on numerous factors, including the integration of different transport systems, the harmonisation between different transport services, and the creation of good physical connections between different systems and services.

All these elements together provide users with a comfortable, reliable, seamless, and fast rail travel experience, which is therefore competitive with the dependence on private vehicles.

Door-to-door solutions generally reduce the overall travel time, but especially through digital solutions they can reduce the impact of some negative elements that influence the subjective perception of travel time such as multiple ticketing, lack of information, "orientation" to the points of exchange, crowding of the means of transport, and the best travel options for the first/last mile.

**Mobility services combination along a route**
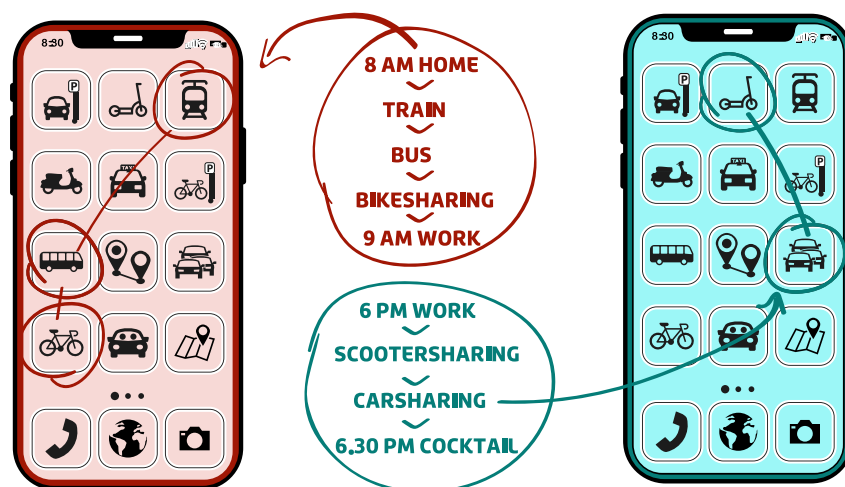
# Focus

## The subjective journey time

The subjective perception of journey time is an important influence on travel behavior and so an important element to take into consideration to make the most sustainable modes of transport more attractive. The table below shows how different convenience attributes of travelling are valued and how relatively uncomfortable certain parts of the journey are perceived to be. A 1-minute delay counts as 3-5 minutes of additional perceived travel time in the perception of public transport users.

**Indicative multiplier of subjective journey time**

| Convenience term | Indicative multiplier |
|---|---|
| Late time | 3.5 - 5.0 |
| Walking with more than normal effort | 4.0 |
| Waiting in crowded conditions | 2.5 - 4.0 |
| Walking in crowded conditions | 2.0 - 3.5 |
| Walking and waiting in normal conditions | 1.75 - 2.0 |
| Standing (depending on conditions) | 1.5 - 2.0 |
| Headway | 0.5 - 0.8 |
| Displacement time | 0.4 - 0.6 |
| Interchange penalties | 5 - 15 minutes |
| On-vehicle information | << 1 minutes |
| Off-vehicle information | << 1 minutes |

Source:EEA

# Multimodality

The expansion and enrichment of the range of shared mobility services allows individuals to use the most convenient travel solution over a certain period of time (e.g. a day or week), as an alternative to the exclusive use of their own means of transport. This condition occurs when individuals use different types of travel using different mobility services depending on their specific needs at any given moment.

If the range of mobility solutions available widens, it will be possible for many to start to prefer the train to the car for a trip from the suburbs to the central areas of the city, or the bicycle to the underground to make a purchase near the office, or car sharing to the bus to return home at night, when the frequency of public transport is generally a lot less.

When this is possible because the availability of mobility services is sufficiently widespread throughout a city, for each trip we tend to use the service and mode of transport in its optimal conditions.

The availability of so-called "bundles" or packages of integrated mobility services favour the integration between different trips taken over a period of time, a possibility that can be easily achieved thanks to the development of Mobility-as-a-Service (MaaS) platforms.

There may be different combinations of services within these mobility packages, depending on the habits and needs of the user/organisation for which they have been created. The content is offered in a prepaid bundle of mobility (minutes, trips, km, etc.) with different services (taxi, bus, metro, car pooling...) that the user takes advantage of, when necessary, as they do today with their mobile phone plan that includes a certain amount of data traffic, SMS, etc.

**Mobility services combination over time: one day, one week...**



Meeting · Lunch · Dinner · Work · Cocktail

Combined deplacement · Simple deplacement
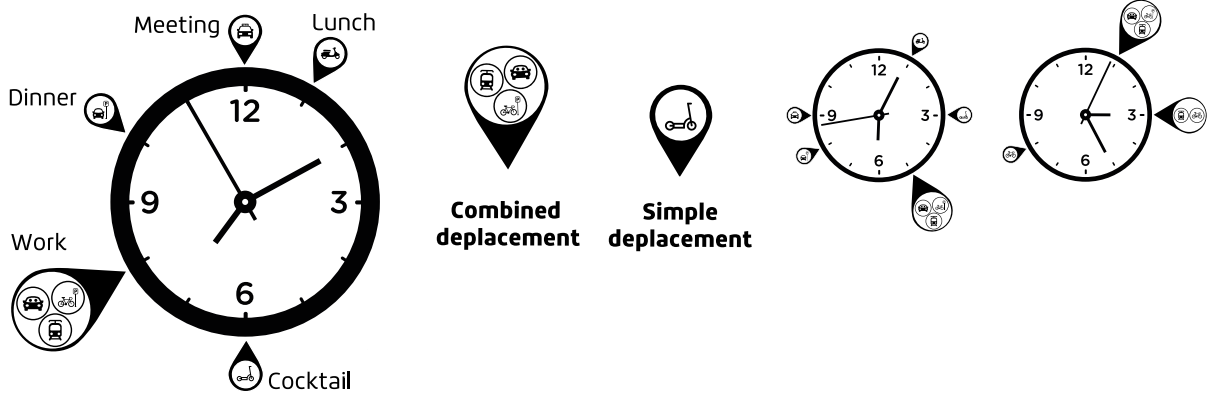
# Focus

## Eltis definition of multimodality

**Multimodality** (not to be confused with intermodality[1]) refers to the selection of alternative transport modes for different trips over a certain period of time (e.g. a day or week). For instance, a person may cycle to work, walk to the shops and use public transport to visit friends. Multimodality (and also intermodality) requires integration of infrastructure and transport services across modes in both passenger and freight transport.

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[1] Intermodal transport refers to the use of at least two different modes of transport during one door-to-door journey. The level of integration in terms of ownership, operation or usability is an important aspect of intermodality. Improving intermodal transport requires the development of seamless integrated transport chains.

**Eltis definition**

# MaaS Platforms
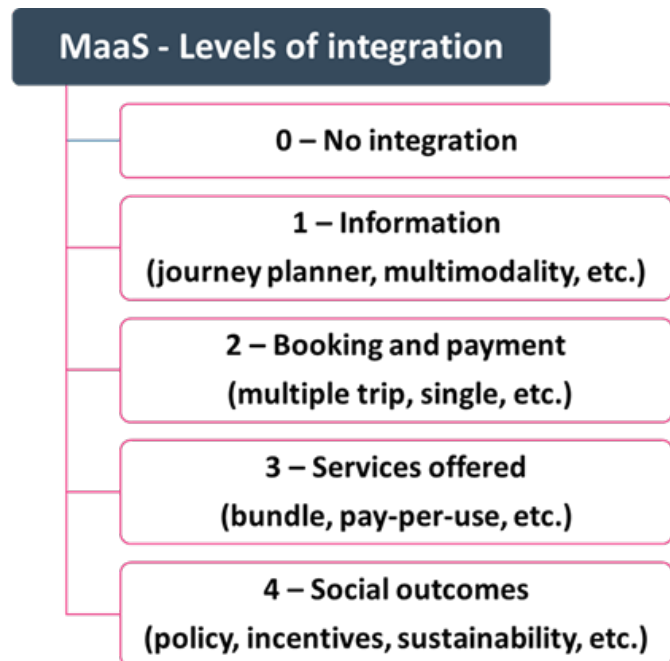## (Mobility-as-a-Service)

MaaS is a tool that enables inter-modality and multimodality, which are key elements in the strategy of a modal shift to railways. MaaS makes real the abstract concept of "multimodality" and encourages "thinking in a multimodal way".

The MaaS platform, as smartphone application, is useful in correcting the cognitive bias of the private vehicle as the only way of getting around, a distorted view caused by a car's symbolic representation of freedom, autonomy and speed.

A MaaS app provides a personal assistant for mobility that directs the user towards the best travel solution to their personal preferences and current situation.

There are generally considered to be 5 levels of integration in the MaaS service generally taken into consideration are five. Starting from a "0" level of no integration, level "1" of information, level "2" of single payments or level "3" of season tickets, up to level "4". At the highest level, the platform is configured as a digital tool that allows for the pursual of political, social and environmental objectives (for example the reduction of the use of private vehicles).

The MaaS "product" is in development almost everywhere in the world, with varying success.

**MaaS - Levels of integration**

- 0 – No integration
- 1 – Information (journey planner, multimodality, etc.)
- 2 – Booking and payment (multiple trip, single, etc.)
- 3 – Services offered (bundle, pay-per-use, etc.)
- 4 – Social outcomes (policy, incentives, sustainability, etc.)

Source: UITP

Difficulties of a technological nature have been experienced, as also have those of a regulatory and governance nature by local administrations and national governments.

The need for change in transport systems is significant, demanding models to be reshaped, which is why the main obstacle is not technological, but rather organisational. There are different ways of building a MaaS platform, which presuppose different types of digital ecosystems in which the five main players of MaaS services operate (end users, MaaS providers, Integrators, Services and Infrastructure Managers).

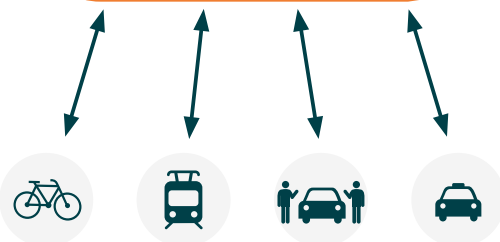**GOVERNANCE AND CONTRACTS**

**END USER**
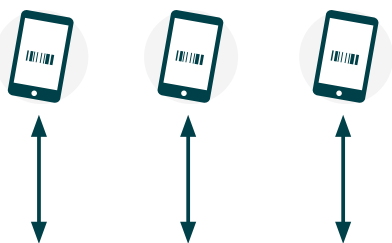
**MAAS PROVIDER**
The front end/service provision e.g. apps and mobility shops

**INTEGRATOR**
The back end e.g. data integration layer

OPEN PLATFORM

**SERVICES**

Stations   Roads   Parking   EV Charging   **INFRASTRUCTURE**

Source: UITP

# Data

The process of digitisation of the transport sector has triggered the creation of huge amounts of both static and dynamic data.

A new type of data is available concerning a passengers mobility behaviors including route tracking, analysis of travel research, and user profiling.

The data that an operator collects on movements, preferences, and attitudes of its users are not merely stored but are the main ingredient of analysis aimed at improving the service offered. The data allows operators to increase integration with other systems and data can now be exchanged or sold to other stakeholders. In this change in the use of user data, it remains essential to protect the privacy of the individual citizen through a framework of certain rules, for example the European Regulation 2016/679 (General Data Protection Regulation - GDPR)[2].

Another key player in the data issue is the public sector, which is also interested both in collecting data on travel behaviours and in monitoring and managing the availability of public and private mobility in its territory as much as possible in real-time. The management and exchange of data between operators and administrations still present various problems, mainly due to a difference in objectives and to the often non-homogeneous data format.

The most frequent data formats are:

**GTFS (General Transit Feed Specification)**: format for mass transit timetables with geographic information. Also GTFS RT (Real Time).

**GBFS (General Bikeshare Feed Specification)**: format created for bike sharing but used for most of the shared mobility innovative services.

**MDS (Mobility Data Specification)**: this is a set of Application Programming Interfaces (APIs) focused on dockless e-scooters, bicycles, mopeds and carshare. Inspired by projects like GTFS and GBFS, the goals of MDS are to provide a standardised way for municipalities or other regulatory agencies to ingest, compare and analyse data from mobility service providers, and to give municipalities the ability to define regulations in machine-readable formats.

Today, transport operators collect data in different formats and methods, making integration difficult. The goal should be the greatest possible standardisation of data acquisition and exchange processes.

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**2** Important initiatives at the European level are also the most recent communication from EU Commission about "European Strategy for Data" (COM/2020/66) and the proposal for a Regulation of the European Parliament and of the Council on European Data Governance (Data Governance Act) COM/2020/767.
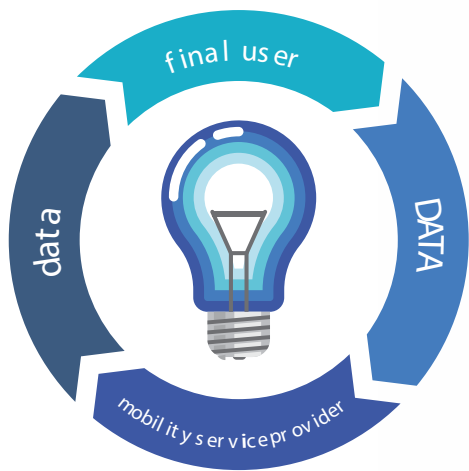
**More Connection**

**More Quality**

**More Effectivenes**

# 4

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# GUIDING PRINCIPLES FOR RAILWAYS

# GUIDING PRINCIPLES FOR RAILWAYS

### 1. TAKE A LEADING ROLE
The mobility service market is experiencing a rapid transformation, with door-to-door and seamless mobility solutions. Railway companies should take the opportunity and lead this new transport landscape.

### 2. PROMOTE AN OPEN, FAIR AND EQUITABLE DIGITAL ECOSYSTEM
The sharing of data and sharing of common rules need trust and cooperation as two pillars of the system. Railway companies can act proactively and become a key driver by outlining and modeling this approach.

### 3. COLLABORATE WITH PUBLIC AUTHORITIES
Railways are in the position of partnering with public authorities, sharing information and digital tools, while together effectively promoting sustainable transport choices to the public.

### 4. LEVERAGE DIGITAL TECHNOLOGY
Railways have the opportunity to benefit from the role of digital intermediary; matching passengers with information, products, and better data to create value for their customers.

### 5. TARGET DOOR-TO-DOOR SOLUTIONS CONSISTENT WITH YOUR BUSINESS STRATEGY
There is no 'one size fits all', railway companies should make strategic partnerships with other mobility solutions that make sense for their business, customer and context. Strategic partnerships must have specific and achievable objectives capable of increasing the competitive advantage of both companies.

## 6. SET OUT BUSINESS PARTNERSHIPS WITH A FAIR AND COLLABORATIVE CULTURE

An aggressive strategy of dealing with other mobility providers, based on railway company's incumbent role, risks being counterproductive; creating a collaborative culture will help make investments in new technologies and new processes more successful.

## 7. TRACK AND ANALYSE MOBILITY DEMAND

Invest in digital solutions that aim to analyse travel behavior of current and potential railway customers. Use that information to improve the service and offering to all customer needs and attract new customers.

## 8. CREATE USEFUL INTERACTION BETWEEN PHYSICAL AND DIGITAL ACCESSIBILITY

Railway stations are the new hub of urban shared mobility:  digital solutions, can offer new analysis tools to guide choices for users and improve station design.

## 9. MAKE SURE THE DIGITISATION PROCESS IS INCLUSIVE

The digital transformation of railways should not exacerbate inequalities, between central and suburban areas, between cities and non-urban areas, between people with higher and lower technological skills and access and between the youth and elders.

## 10. PROTECT DATA

Data has become a crucial corporate asset, and data protection has turned into a topic of strategic interest.  Put in place robust governance to protect your data and the data of your partners.

# 1. TAKE A LEADING ROLE

This the new paradigm of smart mobility could represent a significant risk to railway organisations, if not involved and clearly the backbone to the system, rail could become outdated, by-passed and lose passengers. Maas Platforms also present a very important opportunity, that could help solve the problem of the last mile For railway companies, powerful digital intermediaries could pose the biggest risk should they become overly dominant, i.e. those that enable a connection between the demand for mobility and supply of transport, between passengers and mobility providers. Regardless of who can benefit most from the transformation underway, political institutions, such as the European Union, believe that digital solutions are one of the key factors in promoting multimodality and, as a result, the sustainability of the transport sector. In this scenario, railway companies must take a leading role by investing in technological innovation and promoting integration between different mobility services.

# CASE STUDY

## Assistant SNCF

Developed by e.Voyageurs SNCF, the digital subsidiary of SNCF Voyageurs, the SNCF Assistant application aims to be the **first national MaaS** and to bring together as many multimodal and intermodal services as possible. It is an open platform that all operators are encouraged to integrate, to include the urban areas of large cities and the less populous areas of the country. The goal is to become the reference point for daily mobility, simplifying the user's life and the journey experience, increasing fluidity in the transition from one mode to another.

## RaaS by Renfe

RENFE promotes a MaaS platform – **Renfe as a Service** - to become a leader in multimodal services provision, which includes all public and private modes of transport available in 26 Spanish cities in addition to the train.

## Nugo by FS

There are many examples of railway operators that are engaged in the implementation of a proactive strategy of integration between railways, other mobility services and other operators, creating a **digital platform** with the function of aggregating all these travel options to create the opportunity for a door-to-door journey. This is one of the possible approaches that the initiative could take in the field of door-to-door solutions[3]. Nugo by FS is an application that allows the customer to plan a multimodal trip and purchase a single ticket for the different modes of transport selected. Through partnerships with various local public and private transport operators, Nugo allows for the rail service to be completed, with the largest number of options for the first and last mile.

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**3** Susdef, Passenger door-to-door solutions – **Preparatory study**, p. 83

## 2. PROMOTE AN OPEN, FAIR AND EQUITABLE DIGITAL ECOSYSTEM

An open, fair, equitable digital ecosystem is necessary to increase accessibility, **multimodality**, and sustainability through door-to-door digital solutions. This ecosystem should be based on shared rules and public governance, which aims at avoiding monopolies, preserving competition and enhancing the use of public subsidies. Trust and cooperation are the two pillars of this system.

All the players involved must be willing to share data and services relating to their "core business", both static but also dynamic and in real-time, to allow their integration within MaaS platforms and in all additional services that may be developed in the future. For this purpose, railway companies can act proactively and assume the role of key public governance partners in outlining this new set-up.

# CASE STUDY

### DB Vertrieb GmbH

DB is among the promoters, together with the Heilbronn University of Applied Sciences and the German Association for Human Resource Management, of a work-tank called **Driversity**, an open innovation network for a more modern and sustainable mobility of workers. These three stakeholders are part of an interdisciplinary group that aims at collaborating in the development of solutions and pilot ideas in a real context.

Many and various ideas came up, from a user-traveler profile interconnected to the Mobility Buffet, a sort of MaaS tailored to the specific needs of a business context, and all require important collaboration between stakeholders. The involvement of a railway company in such a project is relevant because it plays an active role in the path towards the digital ecosystem.

## Example of rules

European Regulation 1926/2017 establishes that all information on road, air, sea and rail traffic is standardised and rendered in a format compatible with all types of smartphones to make data and news clear and usable in real-time and available to all. In this sense, each European country must prepare the national access point to multimodal info mobility, through which the exchange and reuse of data within the EU are envisaged. The Regulation establishes the minimum requirements for multimodal mobility information services to be accurate and available. Decisive aspects such as accessibility, exchange and reuse of both static and dynamic data are also regulated.

## Example of rules and governance

Public authorities play a key role in creating a digital ecosystem. The French government, for example, through the **law on mobili ty orientation** (LOM) of 24 December 2019 has fully revised the governance of transport systems to promote light, sustainable and shared mobility and the creation of an inclusive and accessible ecosystem. One of the most impressive and certainly innovative aspects of this law concerns the opening of data. The law defines that public and private transport operators, mobility service providers and infrastructure managers are required to make their data reusable freely, free of charge and immediately. This data is accessible on a single platform that allows its exploitation and re-use by all interested stakeholders.

# 3. COLLABORATE WITH PUBLIC AUTHORITIES

Multimodality and inter-modality are objectives widely included in sustainable mobility plans both at a national and local level. These plans entrust an increasingly important role to the collaboration of stakeholders for their definition. In this context, the railway companies can play a decisive role. They can make available to public authorities a level of data, information, and digital tools so they are able to build the knowledge base for the formation of the plan. But they can also address public choices so that, both nationally and locally, the conditions for the development of digital and physical door-to-door solutions implemented, or in the process of being implemented, by railway companies can be realised.

# CASE STUDY

The collaboration of the RFI Station Management in the PUMS Observatory multi-stakeholder collaboration platform has allowed the company to work with local Italian cities that have a Sustainable Urban Mobility Plan (SUMP) currently being drafted. During this partnership, the Italian Railways have provided much information, allowing local authorities to know in depth the demand for rail transport and the accessibility of the railway stations in their territory. Thanks to this collaborative approach, based on the exchange of data collected through the digital solutions currently available to the company, the Italian railways have been able to ensure that rail transport has been effectively included in the planning scenarios but also to establish a dialogue in other sectors of their business.

**Bologna Municipality and RFI**

A great example can be found in the city of Bologna and in the guidelines for the design of mobility centres drawn up jointly by the municipal administration and RFI. The document provides design guidance that leads to the implementation and construction of the 30 Mobility Centres at railway stations. The goal is to build real intermodal hubs, guiding citizens towards sustainable mobility choices and redeveloping the areas surrounding the stations. For the drafting of the guidelines, the contribution of RFI was fundamental: much of the information used comes from research conducted by the infrastructure manager on the use of the stations and the adjacent areas.
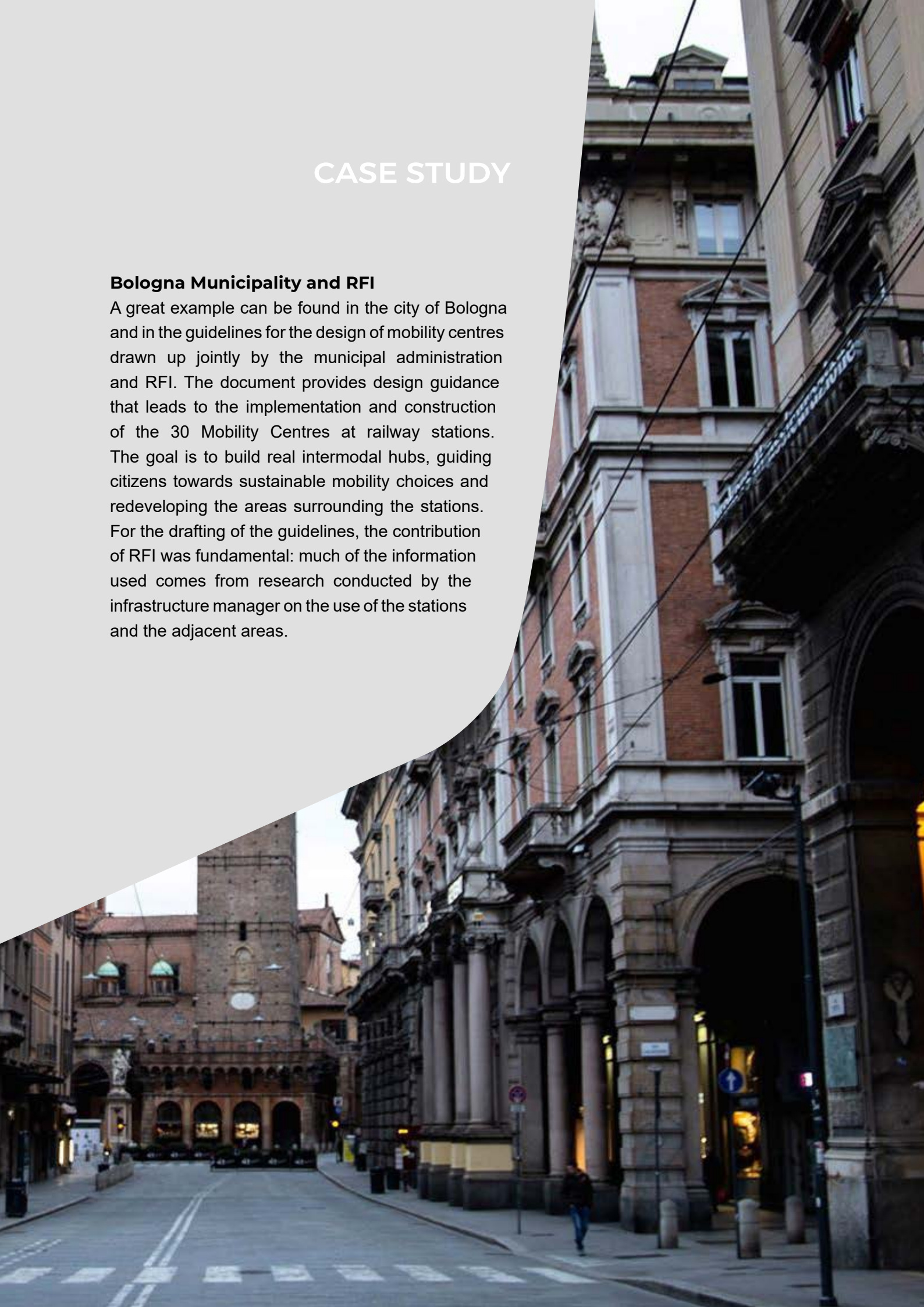
# 4. LEVERAGE DIGITAL TECHNOLOGY

To improve the experience of a railway customer, it is very relevant to know their needs, demands and the degree of satisfaction they derive from the use of the services that an operator makes available to them. The operator and the customer must be able to interact easily before, during and after the journey. In this context, door-to-door digital solutions must improve intermodality - for example in MaaS platforms and more broadly in all digital interfaces that allow continuous interaction between customer, operator, vehicles, services and infrastructures - greatly facilitating this kind of analysis that can also happen automatically and in real-time. For example, the Covid-19 health crisis has highlighted how digital technologies are very useful tools to dynamically manage the overcrowding of trains and stations, thus guaranteeing the safety and operation of the service. Furthermore, a railway company that also has the role of digital intermediary, i.e. that matches persons, information, services and goods has the opportunity to profit from all the typical advantages of a platform such as the fact of relying on data to create value for multitudes of users, and from developing automation and artificial intelligence.

# CASE STUDY

## SNCB

During the pandemic crisis, SNCB has shown that it is possible to offer solutions to ensure greater safety for passengers using data and real-time interactions between the company and travelers.

**MoveSafe by SNCB** provides information on the average occupancy rate of a route at a certain time when the ticket is booked, and information on the real-time occupancy of moving trains, through a mix of real-time information, historical and external data. In this way, the passenger can decide to avoid particularly crowded routes, choose a different time and weigh their choice knowing precisely the sort of situation that they would find on board the train. Such information is also essential for the company both in analytical and predictive terms to define its service.

## JR-East

Covid-19 emergency has accelerated JR East's work already currently underway in solving problems related to demand and passenger traffic. **Immediate solutions** and various tools based on data acquisition were studied to reduce the effects of peak hours, aiming for a "rectangle" model of the homogeneous distribution of demand.

As for users, the railways have aimed to establish a direct connection and through the JR East app passengers can access a series of information in real-time including the actual situation on board the trains in terms of crowding, temperature, and accessibility.

# 5. TARGET DOOR-TO-DOOR SOLUTIONS CONSISTENT WITH YOUR BUSINESS STRATEGY

The process of the gradual adoption of door-to-door digital solutions must take place with prudence and consistently with the company's strategic guidelines, taking into account the evolutionary scenarios of the transport market in which the railway company operates. There are no door-to-door solutions valid for every railway company and in every territorial context. The adoption of new technologies cannot be separated from a profound transformation of organis ational and industrial processes and, more generally, from a redefinition of the role of the railway company concerning the relationship with the new players present in the transport market such as the new operators of "digital natives" mobility (e.g., new shared mobility services) and digital intermediaries (e.g., MaaS operators). For this reason, innovation must take place according to a strategy with specific and achievable objectives capable of increasing the competitive advantage of the company and improving the overall attractiveness of railway services.

# CASE STUDY

## SBB

Railways have always been a central element in the Swiss transport system, highly integrated, with other transport services, such as public transport services in urban areas, including from a pricing perspective. Consistently with this basic scenario, the **Green Class** is one of the first tools that were digitised; a custom mobility package that allows combining the use of the train with public transport, sharing mobility services, the rental of a car with a subscription to electric charging stations, the payment of parking spaces, with everything according to passenger needs taken into consideration. The same can be said for the other key tool of integrated mobility in Switzerland: the SwissPass, a card that allows access to most services in Switzerland, from chairlifts to buses. Since citizens widely use it, it will be progressively replaced by a digital equivalent, the **SwissPass Mobile.**

## NS

For years, because of the modal share of cycling in the transport sector of the Netherlands, the Dutch railways developed a strategy of integration between train and bicycle. This **intermodality model** is based on an efficient network of bike stations at the railway stations. They created many bicycle parking spaces close to the stations, most of which are protected (with dedicated or guarded lockers). Thanks to a turnstile system that enables the passenger to park the bike safely and to avoid queues and bookings at the counter, access to the bike parks is particularly easy. The NS company is also striving in the direction of new bike-sharing services in combination with the use of the train and related digital solutions for efficient and effective use of this type of new intermodality, with the aim of limiting the construction of new parking infrastructures.

# 6. SET OUT BUSINESS PARTNERSHIPS WITH A FAIR AND COLLABORATIVE CULTURE

Traditionally, different modes of transport are considered separately. While this reflects how the industry operates, it does not reflect the way people think about getting around their city or territory. When planning the commute to work or a long-distance trip, people think about the cost, convenience and complexity of the entire door-to-door journey - not simply one element of it. For this reason, railway companies should actively collaborate with other mobility providers to jointly build an integrated transport offer. To promote a collaborative approach and establish a climate of mutual trust, railway companies should aim to entrust public authorities with the role of creating the framework of rules and standards for the digital integration of different types of mobility services, in particular when integration takes place in an urban environment. An aggressive strategy of integrating railway companies towards other mobility providers risks being counterproductive, making large investments in new technologies and new processes ineffective, slowing down the process of forming an ecosystem favorable to multimodality. However, if railways fail to establish collaborations with other operators, they can implement vertical integrations to create new intermodal mobility services.
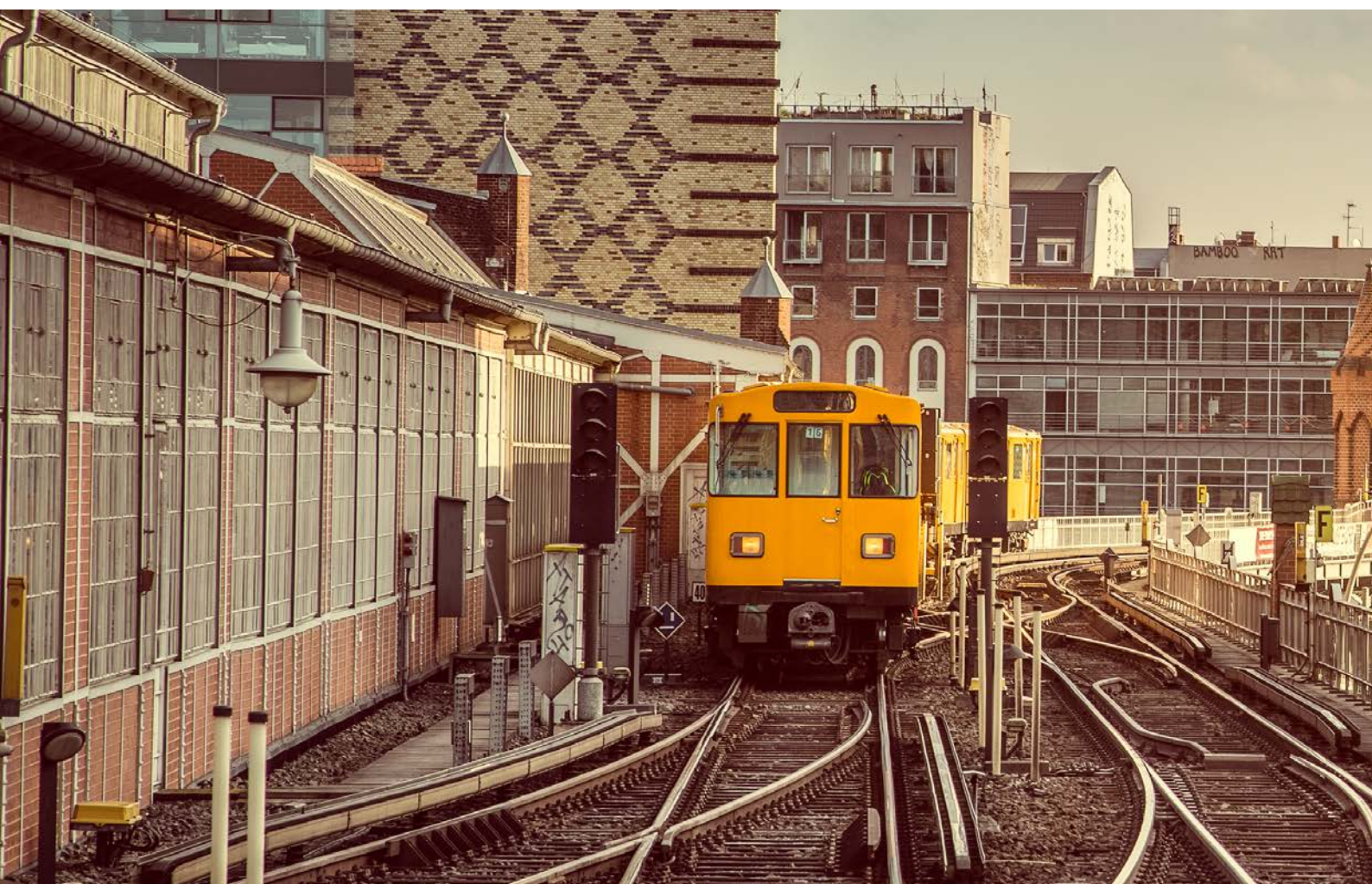
# CASE STUDY

## DB

**Call-a-bike** is the bike sharing service managed by DB which with over 16,000 bikes in 70 German cities is the second largest bike sharing operator in Germany. The service was launched to meet the need for mobility in connection with railway routes. It is designed to be as complementary as possible to rail mobility and to offer a sustainable solution for the first and last mile to passengers travelling by train. Most of the stations where Intercity-Express trains pass have at least one Call a Bike collection point where you can pick up a bike.

# 7. TRACK AND ANALYSE MOBILITY DEMAND

It is crucial to invest in digital solutions that aim to analyse the movements, behaviours and habits not only of current customers but also of potential ones, to develop multimodal services. Analysis of the mobility demand with high level of details that new digital technologies offer today, the opportunity for new transport services and the optimiSation of current services may emerge, for example by improving the interchange between the different types of railway services. At the first stage, the collection of data and metadata can take place with the acquisition of data produced by external subjects and by connecting them with those obtained by collecting the output of their users, although, each railway company should identify how it obtains and analyses a large amount of data on individuals' demand for mobility.

In this regard, it is always useful to rely on the collaborative feature of platforms that allows them to obtain information from all the parties involved instead of obtaining it through other means.

# CASE STUDY

## Jelbi by BVG

Regarding the availability of solutions that focus on the user, one of the best examples is certainly that of the **Jelbi MaaS platform**, developed by the Berlin local transport authority (BVG). Jelbi's mobility network integrates DB's rail service with Berlin public transport and the main shared mobility and car rental services into a single MaaS platform. The app is designed and built to be user-centered and makes it very simple for passengers to pay for their travel. Clients do not need to register for every single service and can keep all virtual tickets in one place. Moreover, thanks to real-time tracking, passengers are up-to-date on traffic conditions and can easily reschedule their journey in case of unexpected changes.

## TrainOSE

The Greek railways **TrainOSE** have developed various integration solutions between train and other modes of transport, elaborated on the basis of information on the movements of passengers before and after the train journey. In particular:

- The City of Patras. Since the station is located far from some key points such as the university and the hospital, the train was not the first choice for many travellers who had to reach these points of interest. The problem was solved with a dedicated bus line and the possibility of purchasing an integrated train + bus ticket that facilitates intermodal travel;

- Greek islands. To reach the Greek islands, TrainOSE created a package that includes in a single ticket the train and the ferry trip, allowing passengers to move easily from one to the other at the port of Piraeus.

## Tracking Tools

Many software tools that aggregate data are available on the market, programs that combine innovative collection methods and sophisticated algorithms to produce complete and accurate data on the movements of vehicles and users. These tools are useful for mobility operators, local administrations and any other interested party because they offer the possibility to view real-time data on fleets, trips, and sharing mobility operators. Thus, they are a good starting point to analyse the movements of people who use mobility services complementary to rail transport.

Applications to aggregate information on cyclists' routes are also interesting tools. In some cases, these are journey planning apps keeping a record of all the routes taken by users. In other cases, the applications are precisely oriented towards evaluating the route and, for example, calculating the emissions saved thanks to a more sustainable choice.

# 8. CREATE USEFUL INTERACTION BETWEEN PHYSICAL AND DIGITAL ACCESSIBILITY

All railway stations are potential mobility hubs, i.e. places where there are many interchanges between various modes and means of transport and mobility services. Depending on the railway traffic, the geographical context in which they are located, their role in the transport network, each station must guarantee to "process" as many interchanges as possible with efficiency, safety and ease of use. Consequently, the station and its adjacent spaces must be configured to ensure this type of performance. Even in this case, digital solutions can offer new analysis tools to guide choices, monitor their effects from the user experience side, and promote the improvement and optimisation of the solutions already adopted. Data analysis methods and tools provided by digital solutions should be selected according to a plan to avoid unnecessary data collection and, on the other hand, to seize the opportunity to obtain useful data with the least amount of effort required.

# CASE STUDY

## STPs

A partnership between the railway industry, local authorities and other stakeholders was born in England. They developed a tool - the **Station Travel Plans** - for improving the physical accessibility of stations by encouraging integration with other modes of transport.

This document analyses the features of different STPs and it highlights the main strengths such as exchange parking lots, the possibility of buying integrated tickets, and the availability of shared mobility services.

Thanks to digital data, STPs make it possible to bring about the shift of the first and last mile to more sustainable modes of transport and at the same time to increase customer satisfaction by making the experience of the station as a place of exchange easier.

## RFI - RETE FERROVIARIA ITALIANA

One of the main objectives of the RFI (Italian Railway Network's) Station Plan and the competent company division is the **redevelopment of the external areas** transforming them into assets to enhance the accessibility and attractiveness of the station area in its entirety. RFI's design approach is guided by three principles that redesign the role of the station in the urban context and physical space of the city around it: safety, intermodality and environmental sustainability.

The various projects started intend to change the face of Italian cities and above all the role of stations, from simple railway junctions to hubs of integrated urban mobility. Much of the information used to design the stations' new areas come from studies that the RFI has carried out on how passengers utilise stations and the areas adjacent to them4.

**4 Look at RFI initiative about elevators in stations.**

## Tools for monitoring passenger flow

There are powerful software programs that, via Wi-Fi networks, process the position of users inside the station and in their proximity and trace their movements by feeding databases on customer flows, which also take into account business information such as station maps, tickets sold, etc. These data forms the basis for detailed flow analysis and can play a key role in making customer-driven decisions.

## SNCF

French railways launched a **contest** on social media to decide which was the most beautiful French station, to engage the public who frequent the stations by inviting them to give their opinions and preferences or to vote for the station in their territory. In this way, leveraging the multitude of users who use social platforms and their participation, SNCF not only showcases its architectural jewels and its brand but obtains very useful information on the satisfaction of the places frequented by its customers and on their preferences and inclinations.

# 9. MAKE SURE THE DIGITISATION PROCESS IS INCLUSIVE

The main risks related to the use of AI concern the application of rules designed to protect fundamental rights and values as applicable in certain domains, including non-discrimination based on sex, racial or ethnic origin, religion or belief, disability, age, or sexual orientation. Railways have to manage this aspect in the digitisation process of their services. In particular, they must pay attention that risks might result from flaws in the overall design of AI systems (including human oversight) or from the use of data without correcting possible bias (e.g., the system is trained using only or mainly data from men leading to suboptimal results concerning women). Conversely, the digital transformation process should reduce inequalities in the access to mobility services between the centre and the suburban areas, between cities and non-urban areas, between people with higher and lower technological skills and between the young and old generations

# CASE STUDY

## Guidelines for Seattle's DOT

The city of Seattle in its **Seattle Transport Information Infrastructure Plan** declared itself willing to work with local communities to build a racially fair and socially just transportation system. In the guidelines addressed to the city's Department of Transportation, there are several examples of typical travellers to pay particular attention to in terms of inclusion. Moreover, they show the case of mistakes made in the past by the administration specifically because they did not take into account the inclusion of the weakest groups of the population in its digitisation strategies.

## VIA Rail Canada

An example of leveraging digital solutions to improve social inclusion is provided by the Canadian railways which have adopted, on an experimental basis, specific support technology dedicated for **passengers with visual impairments moving around the Ottawa station**. VIA Rail Canada, in collaboration with the UIC, has successfully tested the combination of two digital technologies to improve accessibility and wayfinding for passengers with visual impairments inside the station.

# 10. PROTECT DATA

The digitisation of services and the creation of new solutions for passengers, such as door-to-door ones, give rise to the implementation of new technologies and new processes. The new infrastructures and digital platforms highlight the role of data as a key element for the functioning of the services offered to customers.

Thus, data becomes a crucial corporate asset, also from an economic point of view, and data protection turns into a topic of strategic interest that requires an approach capable of taking into account the context of every single company and the factors that can influence it.

# Focus

The **General Data Protection Regulation** came into force in Europe on the 25th of May 2018. Its purpose is the standardisation of the regulation on the protection of personal data in the EU.

The GDPR increases citizens' trust in digital companies and establishes more stringent protections. In this way, it helps to further aid the digital development of the EU and guarantees the protection of the free movement of personal data.

The lack of transparency and the fear of the improper use of their data can scare users and that can be avoided and prevented with clear regulations.

Digitisation must not create additional risks for the privacy of individuals but, on the contrary, should provide customers with a framework in which they can move safely.

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