

# **STATIONS IN THE FACE OF THE HEALTH CRISIS**

**Research Report held in 2021.**

**Nacima BARON, Univ. Eiffel,**

## **SUMMARY**

**1. FROM TRANSITION TO ADAPTIVE RESILIENCE**

**2. SECURING FRAGMENTED SPACES**

**3. RAIL OPERATORS' RESPONSES TO THE HEALTH CRISIS**

**INTERNATIONAL BENCHMARK**

**4 GOVERNING THE HEALTH CRISIS IN AND THROUGH TRANSPORT**

**5. HEALTHY, SAFE, RESPONSIBLE, SMART:**

**FOUR LINES OF COMMUNICATION**

**6 - REBUILDING CONFIDENCE IN PUBLIC TRANSPORT**

# 1. FROM TRANSITION TO ADAPTIVE RESILIENCE

## 1. Stations and the railway world: a system undergoing profound change

The **structural transition**, which is a long and low-profile process, is the result of the gradual integration of **regulatory changes and new regulations, first European and then national**, in station spaces, jobs, approaches to service and the relationship with users.

The transition in the world of train stations began in 2009 in France with the ORTF Law and the 2012 Decree on stations. The general idea was to create an entity that was initially part of the mobility branch, recently attached to the Network, but was sufficiently independent to manage the assets and guarantee neutrality with regard to mobility operators in the long term. This dynamic leads us to consider stations as essential goods and assets from which different types of values are produced and exchanged: land, flow and time. The whole logic of station management is based on the assertion that there is a virtuous circle between growth in the number of passengers (or station users, who could be either passengers or residents local to the station and who come to make purchases) and the whole system of regulation and management.

## 2. Safety and security issues: managing a tense transition

Expert Mark Beecroft (source: *The future security of travel by public transport: A review of evidence Research in Transportation*, 2019, Business & Management journal) addresses three central questions: current security issues in transport networks, emerging security issues and the increasing role of technology in addressing them.

In his view, **current security issues** are mainly associated with the management of interfaces between the station and the urban space (forecourts, the station area) and between transport systems and the management of intermodal hubs (articulation between train stations, bus stations and the road network).

The **growing connectivity of metropolitan traffic patterns** must be taken into account as the basis for all reflection on the overall security of urban systems. Indeed, security risks are associated with the fact that the station is part of a wider world of metropolitan traffic and that **passenger flows, and not spaces as such, must be made safe**.

This fundamental reorientation of security improvement creates a shift from:

- a site-based approach ("area-based" management) to a circulatory approach using thresholds,
- management of individuals (search for delinquents or undesirable people) to collective management (crowding and flow management).

This requires an adaptation of the skills and operating regulations of security and safety professions. According to Beecroft, the world of public transport needs to increasingly base service production and consumption on the use of data, not so much in a predictive manner but more based on the real-time adjustment of flow volumes, stops and routes. The emerging challenges in safety and security in public transport systems therefore consist in designing, setting up and evaluating secure modes of production and use in this increasingly technologically mediated world.

These emerging challenges require the construction of **knowledge exchange systems** because the combination of knowledge from the field and the experience of today's security actors, in the framework of current practices, is an essential and necessary basis for the integration of new challenges and new future practices.

Furthermore, adapting to the new security challenges means that the starting point is not so much the facts (identifying, locating, isolating, "invisibilising" malicious attitudes and criminal acts) as the creation of a relationship of controlled behaviour and friendly support.

### **Monitoring and supporting groups and individuals: the surveillance/confidence balance**

Reinforcing the personal safety of customers includes guaranteeing global confidence in the fact that the journey by public transport via the station will take place in optimal conditions of physical and psychological comfort - with certainty as to the punctuality and efficiency of travel to the destination - in terms of both the passenger's physical safety and their subjective choices and autonomy: being able to "navigate" through the station space, move around freely, choose which route to take, etc. In short, to enjoy autonomy and transparency in their use of the site. From the point of view of those involved in station security, this aspect contrasts with increasing surveillance and control, which the user also has to accept as well as obeying new rules governing behaviour. If the transport space, which is increasingly technologically controlled, is a place for behavioural reform, it is essential that those involved in the overall security of stations work upstream and trace the origin of issues: mobility behaviour and its determinants, the needs and attitudes of mobility users and interpreting situations of apprehension, fear or insecurity, not only in relation to places and other users, but also by using data-driven mobility tools and technologies.

### **3. The health crisis: short- and medium-to-long-term effects**

The health crisis has caused major shockwaves by undermining approaches to maximise footfall in stations through the application of barrier gestures and social distancing.

Everything has been reversed. The principle of flow fertilisation (selection of high-value customers or services with a high capacity for return per square metre) has been called into question. Previously, spaces were optimised by filling stations to the point of physical saturation (provided that standards for the circulation of users and staff were met) and intensifying value production per unit of surface area or client. The health crisis has led to the de-densification of station spaces and generated a reflex of fear of others and physical distancing between individuals.

Since the spring of 2020, the health crisis has provoked a series of major upheavals. Railway systems have had to very quickly reorganise themselves and implement solutions for restructuring space and redistributing functions. The application of sanitary and social distancing measures is accompanied by the reinforcement of flow management and increased filtering, and the management of interchanges must be coordinated in collaboration with an even greater range of actors such as public authorities and local communities.

The poster, taken from the article by Gutierrez et al., illustrates the short-term effects of the COVID-19 crisis on public transport systems and attempts to re-articulate them with longer-term trends.

#### **The short-term trends are:**

- travel restrictions
- messages about avoiding or limiting access to public transport
- encouragement to use alternative modes (environmentally friendly and active modes)

#### **The medium- and long-term trends are:**

- delivery of a safe and reliable transport service
- promotion of sustainable modes

- reduction of inequalities in access to transport and destinations

**The research agendas for the reorientation of public policy objectives for public transport are:**

- studying the evolution of behaviour and representations of transport (hypothesis of a sense of disaffection with public transport or an urban exodus for fear of contamination)

- analysing the responses of public actors (in the fields of railway and metropolitan planning policies)

- monitoring the effects of adjusting transport services on the conditions of accessibility of populations and spaces, with the definition of tools to address the issues of reinforcing socio-spatial inequalities.

**4. Toward post-pandemic resilience: what is the “new normal” for stations?**

The COVID crisis can be broken down into three periods, which require an agenda for adaptation and resilience in the operation of public transport and the organisation of station security.

**Lockdown:**

Severe disruption leads to the adoption of emergency measures. These measures consist in thinking first and foremost of health security and designing a “rescaled” public transport service to meet immediate mobility and traffic needs in the best health and personal security conditions.

**Post lockdown and before generalised vaccination:**

Order is brought to the disruption. Public transport actors design and implement acceptable levels and forms of public transport use.

The “socially distanced” station appears. It is adapted to the social functioning of cities in which all interpersonal relations are organised according to a new measurement: the “1.5-metre society”. The aim is to manage public transport within “healthily acceptable” limits and minimise the inconveniences of transport limitation for the functioning of society and the economy.

It is a time of multiple adjustments, with periods of strict or less-strict lockdown and curfews that require operational responses to be flexible.

It is also a period of experimentation with new tools (particularly technological), institutional partnerships and means of communication to the public and users, as well as accustomation to new behaviours.

**After vaccination (or post pandemic):**

Transport services return to normal, but this may be a “new normal”. Assessments are carried out to identify what should be kept and what should be discarded. New behaviours, new ways of using public transport and new representations acquired by users are also part of a certain long-term adaptation process. The recovery period is one of transformation that can reorientate the underlying trends of the more structural changes in the transport sector. In this period of the “post-health-crisis” station, the distribution of skills, responsibilities and power sharing are re-balanced. A new balance of power, linked with the consolidation of some of the experiments launched at the height of the crisis, emerges.

# Conclusion

## 1. This text addresses three issues:

- the long-term transformation of station regulation
- more context-specific restructuring linked to the health crisis;
- changes underway in public transport security;
- **Stations are public spaces** and partially reflect **the deterioration of living conditions in the neighbourhoods** in which they are located.
- Stations are also **network nodes**, not only of rail networks, but also of all kinds of traffic networks connected with the train lines. As such, they also concentrate increasing levels of **juvenile delinquency**.

While loitering, aggression, harassment of women, malice and petty incivilities are very distinct issues, they are much less distinctly perceived in public opinion, with over 200,000 cases reported annually. **Stations crystallise a feeling of insecurity, to which is now added the fear of contamination which is also, essentially, rooted in the fear of others. Public transport is faced with the challenge of adapting in the short term and establishing new rules of use to restore confidence and encourage clients to return to everyday and long-distance transport.**

## 3. COVID requires urgent adaptation of station operations

The health crisis has led to **major service adaptations**, forcing users to comply with **new behavioural standards** (new boarding systems, social distancing, signs on the ground). Paradoxically, the **reduction in crowding** does not necessarily create fewer **crowd problems**, **because the challenges of regulating the security and health crises in stations all come down to the same thing: how to enforce barrier gestures and effectively manage access and crowding, how to recreate ties with customers and offer explanations, reassurance and support.**

## 2. This text highlights the dissociation of temporalities in the changes underway:

For the world of stations and station security:

- there is a "pre health crisis" period. In terms of shared responsibilities, this "pre health crisis" period was already unstable, uncertain, uncomfortable and conflictual, perhaps because it was marked by a painful transition.
- there is a "during the health crisis" period that combined an amalgam of immediate responses based on emergency management, questions and experiments.
- there is a "post health crisis" period in which certain achievements of the health crisis are consolidated and a new institutional landscape is defined along with the construction of new partnerships and new ways of doing things. This is true for the railway system, the world of station management in the broadest sense and the field of railway security.

All in all, the station of tomorrow will be even more governed and managed by:

**1 – the regulation of access and interfaces** with the city and transport networks (rail and others). This raises questions about territoriality in train stations and the identification of different territories according to the different functions, limits and physical and virtual restrictions (barriers, pathways)

that differentiate these territories. It will provide the opportunity to reflect on the role of station and rail security staff in filtering operations.

**2 – the reorganisation of pedestrian routes in stations** (flow rates, circulation systems, activities associated with transport). These routes are based on footfall, architectural dimensioning devices (corridors, escalators and staircases), circulation norms in terms of form (laminar flow such as queues), speed (from stationary while waiting to different flow rates) and degrees of compactness linked to health issues. It will provide the opportunity to reflect on associated measures to be adopted by railway security professions in connection with new visibility and mobility conditions in stations.

**3 - selective identification of clients through remote monitoring (using technological tools) and contact, which also implies greater control and is built on a relationship of goodwill.** There is no doubt that the health crisis has widely accelerated the digitalisation dynamic that was already underway. Stations produce and consume massive data through their different activities, including those governing safety and security. This data is used to target attractive customers and can also be used to identify at-risk or undesirable groups (in terms of health or behaviour).

## 2. SECURING FRAGMENTED SPACES

Structural changes, such as more tactical adaptations of the layout of station spaces as a result of the health crisis, are reflected in the increasing definition of sub-spaces in connection with their functional redesign.

User routes are structured around multiple journeys from one space to another such as access, sales, waiting and boarding spaces. The station is organised around tasks allowing the user to cross obvious or discrete physical thresholds under strict time constraints. The feeling of insecurity is greatest when moving from one space to another.

The health crisis and social distancing increase congestion in stations and force the management of circulation into bottlenecks.

## 1. DIFFERENTIATED SPACES AND THE REDESIGN OF CIRCULATION IN STATIONS

Large stations are traditionally caught in tension between the appearance of a neutral, open and accessible public space and the reality of a closely monitored space governed by strict regulations in terms of access and acceptable people and behaviour.

A series of major architectural renovations has accompanied phases of renewed urban integration and technological change (high-speed TGV trains, opening of interchanges with trams, RER lines, etc.).

A recent phase in the reorganisation of station spaces is linked to the functional redesign of stations, the reallocation of spaces for the development of commercial areas and the promotion of consumer and leisure activities in stations. One of the effects of the introduction of European regulations in the last fifteen years is that station spaces are subject to regulatory zoning, creating variations in the generation of deregulated revenue (hyper-core, core, etc.). These zones differentiate the space. The station is divided into a succession of functional sub-spaces with varying levels of profitability.

The above figures show the development of a differentiated approach to station spaces (orange and red zones) using the example of the ground floor level of the Gare du Nord. This distinction makes it possible to exploit a differential in marketing potential according to the type of traveller.

- On the east side, near the entrance from the street, there is a post office, tobacconist's and affordable food and drinks store allowing morning commuters, who have the least time available (often less than 10 minutes) to make **routine purchases** without wasting time (buying stamps, a coffee, bottle of water or newspaper).

- Leisure and "professional" travellers on TVG trains, who board in the middle of this transversal platform, have between 15 minutes (for frequent travellers) and 30 or even 45 minutes for leisure travellers. These people are exposed to a more diversified offer. They might also yield to **impulse purchases** (gifts, chocolates, pastries), unless they resist, but, if they are commuters themselves (which, as we have seen, they often are), they will be exposed to the same shops again on their return in the evening and might then make a less impulsive and more "thought-out" purchase.

Assigning potential values to space intensifies the use of station spaces and focuses the attention of station managers on passenger flow. Flows are reorganised according to this form of regulation. The large central panel showing the platforms of each train has been removed and replaced by a set of electronic panels. The whole space has been restructured around fluidity of circulation and the fertilisation of flows. This flow (in terms of volume, distribution in time and station space, its composition between long- and short-distance travellers, etc.) must be exploited through exposure to different opportunities, activities, experiences and atmospheres.

From the station threshold to the train door, this leads to a chronological and pedestrian-centred layout of spaces and activities. This space-time journey works like an obstacle course and can be read as a sequence of visits to compartmentalised spaces with an increasing functional dissociation of environments within the travel building.

Flows are slowed down by bottlenecks (escalators, automatic ticket barriers at the entrance to platforms, security barriers (Thalys)). Access to the station is restricted when flow is obstructed too much or for too long.

## 2. STATIONS ARE COMPARTMENTALISED BY AN INCREASING NUMBER OF THRESHOLDS TO BE CROSSED AND A GENERALISATION OF LAMINAR MODES OF CIRCULATION (QUEUES)

Travellers are required to cross a series of physical or virtual thresholds. The location of these thresholds is not necessarily fixed, or as little as possible. Stopping points (such as information counters or booths) are less and less common and sought after.

**Governing circulation through stations using flows means increasing the number of thresholds.**

**There are four types of thresholds:**

### 1. Commercial thresholds

**These are designed to fight fraud.** They are found in different forms in local and central city stations and use a variety of technologies. A ticket must be presented in order to pass.

Large numbers of ticket types have led to different types of barriers, but the use of multimodal transport raises the issue of merging these different technologies to allow travellers to swipe their travel card once only.

### 2. Security thresholds

### **These aim to deter and prevent terrorist attacks (ram cars, explosives)**

On the one hand, protective bollards are used at the entrances to stations and multimodal transport exchanges, such as forecourts and interchanges.

On the other hand, security gates similar to those in airports are also becoming more frequent. They are generally used in high-speed-train stations (in Spain) and sometimes to access the station (in Russia) or a specific line (such as the Eurostar in the Gare du Nord).

They are based on metal detection devices. They momentarily separate passenger and baggage routes through different spaces.

In Spain, large stations were widely redesigned to separate parts of the station using these gates after the Atocha incident in 2004 (193 deaths).

These developments lead to the reorganisation of traveller flows and the restructuring of boarding systems before the gates, because crowds often form and, in certain cases, queues may need to be organised (such as temporary boarding queues or permanent queuing areas).

### **3. Mobility thresholds**

#### **These are used to manage pedestrian flows**

All stations experience bottlenecks at points where the flow of passengers is concentrated as they converge to cross a single barrier: station entrances, escalators, stairs, etc.

To avoid crowding and increase flow, it is preferable for it to be given a laminar structure beforehand so that users follow a linear path in single file. This is the aim of installations such as barriers and markers, which form queues ahead of convergence points like escalators, creating passenger selection and pedestrian flow “shaping” points in these zones and at station entrances. These are also priority areas for surveillance camera monitoring.

When used to enforce social distancing rules and limit the number of people in the station, these devices, which were initially designed to filter and increase the fluidity of flow, momentarily retain travellers and block the entrance to the station.

In Asia, where 30-minute times slots are allocated for entering the station, these devices are used to make sure that each passenger is in the right slot. In Russia, they simply regulate the filling and emptying of the station and harmonise the arrival and departure of trains with the filling and emptying of boarding platforms, halls and bottlenecks (especially escalators).

### **4. Towards health thresholds?**

In certain countries, especially in Asia, health checkpoints have been installed at station entrances. They contribute to creating laminar flow at the entrance and submit travellers to routine checks including:

- taking their temperature
- disinfection with hydro-alcoholic gel
- sometimes facial recognition or user identification

These points are new station circulation hotspots. They contribute to fragmenting the station space, slowing down flows and forming queues.

### **3. THE ADDITION OF ALL THESE THRESHOLDS FRAGMENTS THE STATION SPACE**



Commercial, security, mobility and sanitary thresholds are based on four approaches to spatial use in stations (to simplify).

Overall, the health crisis has reinforced structural changes that have been under way for at least a decade.

Station spaces are being fragmented for security, health, mobility and commercial reasons and travellers are “protecting themselves” from each other with invisible walls and different degrees of obvious, formalised, permanent or temporary thresholds. Free circulation is organised into a more laminar form, leading to the creation of temporary or permanent queues.

The health crisis has underlined the question of access to the station at the interfaces with public spaces or other transport networks. It reinforces the dynamics already at work. It produces:

- new "at risk" users
- new risk behaviours (failure to wear a face covering or comply with social distancing rules).

These lead to the creation of increasingly monitored circulation patterns and new systems of control, which are superimposed and concretized in a more fragmented station space.

As seen in Asia, where health considerations are better integrated by users and organising authorities, there is a tendency for “health” thresholds to remain in the space and for filtering procedures to be continued after the relaxation of health rules.

## 3. RAIL OPERATORS' RESPONSES TO THE HEALTH CRISIS

### INTERNATIONAL BENCHMARK

- Transitions in railway regulation are a global issue, affecting most developed countries which, like France, have begun numerous projects to transform stations (renovation, expansion, new services, etc.).
- The rise in security threats and the way in which they affect stations can be found to varying degrees in multiple countries.
- Lastly, the health crisis impacted all the actors of the railway sector at the same time and all over the world. The way in which the issues were addressed varied greatly.

We analysed the websites of the organising authorities and railway companies of the following cities: London, Madrid, Washington DC, Beijing, Seoul, Singapore, Moscow.

#### **The analysis covered the following points:**

1. - Identification of the adaptation of public transport services during lockdown
2. - Nature of the information provided to users during and after lockdown
3. - Adoption of COVID measures for managing distancing, the wearing of face coverings and hygiene rules
4. - Roadmap for the resumption of post-COVID activity
5. - Profiling the communication strategy

## 1. Four reductions:

### A. Reduction of the services offered

At the start of the health crisis, metropolitan rail operators all over the world reacted very abruptly by **reducing service on all lines in the network**: metro, local trains, buses and trams.

At peak moments in the health crisis, some **bus and train stations were closed and stops were “skipped” by the network operators**.

Depending on the case studied, these were either:

- stations and networks in peripheral neighbourhoods with high-density collective housing lived in by people on lower incomes and populations considered to be at risk (obesity etc.) with high fatality rates.

- stations and networks in central neighbourhoods, lived in by well-off but cosmopolitan populations who often travel abroad and were likely to have contracted virus strains in foreign countries;

- interchanges between these two types of stations and networks: particular attention was paid to these “hubs” by state and metropolitan control centres in charge of dealing with the health crises.

These three options led to very different impacts by the pandemic in the metropolis.

### B. Reduction (or collapse) of demand

Metropolitan networks experienced extreme variations in public transport use, with complete stoppages in the case of a strict lockdown. This was followed by an increase in both supply and demand that is currently being closely analysed and modelled, especially in China where this increase is strictly controlled by rules governing access to stations and trains.

This reduction was drastic, even total during lockdown, with sharp variations between periods of lockdown, release from lockdown and curfews, and traffic remained far below the usual volumes, even several weeks after the relaxation of travel restrictions.

The decline in the use of public transport and crowding in stations is linked to two reasons:

- a modal shift: users turned to other, private modes of transport (cars) and active modes (cycling or walking), especially in cities in which adjustments were made to the road network such as “corona-cycle” paths, wider and more pleasant pavements for the higher number of walkers travelling longer distances, and sometimes new rights of way to fluidify the circulation.

- urban exodus: with the rise of teleworking, city centres were depopulated in a generalised, albeit not yet well documented, way. Residential adaptation strategies have been observed in both directions:

  - from the centre to the peripheries, with the occupation of second homes in the countryside;

  - but also the movement of certain professionals, particularly medical practitioners, toward the city centres to furnished accommodation or residences. These are key workers who decided to no longer rely on public transport for health reasons. They were looking for “transit free commuting trips” and rented studio flats within walking or cycling distance of their workplace. This shows that adaptations driven by specific circumstances can have a long-term effect on the new organisational and economic equilibrium of stations.

For this reason, some transport operators quickly began partnerships with micro-transit operators (self-service bikes, electric bike and scooter hire companies) and local authorities to redirect public transport users to alternative modes transport, and not cars if possible.

### C. Decrease in the capacity of station spaces (and trains) due to the application of social distancing measures.

Social distancing rules vary from one country to another.

The WHO recommends distances of 1.5 to 2 metres, whereas the standard distance used in France is 1 metre.

A comparison was made based in the difference between the usual capacity of transport spaces and local trains and the capacity after application of social distancing rules.

A distance of 1m leads to a capacity of 90% to 93.5%

A distance of 1.50m leads to a capacity of 82% to 91.3%

A distance of 2m leads to a capacity of 60 % to 88.4 %

For a distance of 1.50m: 23% of peak time users are unable to use the network.

For a distance of 2m: 43% of peak time users are unable to use the network. This data was taken from Rishnakumari and Cats (2020) for the first figures, and Gkiotsalitis and Cats (2020) for the second and was based on real analysis from Washington DC and its transit authority, the WMATA.

### D. Sharp decline in revenue and income for station managers and transport operators

The health crisis brutally deprived certain entities (organising authorities, railway companies, contract operators) of transport ticketing revenue.

Shops in stations were either closed (as was the case of a large proportion of food shops) or faced sharp variations in revenue.

This led entities to explore all avenues of cost reduction and revise their investment plans.

## In conclusion

In all the cases studied, the authorities tried to structure responses in a staggered way, from emergency management (application of hygiene and social distancing rules) to working to maintain a robust service (through the teams and organisation), and then to implementing longer-term resilience responses.

Several white papers have been published, such as the one by the APTA (American Public Transportation Association) titled *Developing a Pandemic Virus Service Restoration Checklist*.

These papers focus on the reorganisation of public transport operators' responses based on three key lines:

- the **front line** which coordinates the installation of hydro-alcoholic gel dispensers and the reorganisation of traveller routes in stations and drafts communication.
- the **hot line** which redimensions and decides in real time on robust capacity adaptations
- the **offline** which designs and prepares for the "new normal": new areas for investment and training.

## 4 GOVERNING THE HEALTH CRISIS IN AND THROUGH TRANSPORT

Transport actors and station operators deployed four levels of response to the health crisis in stations:

- **preventive measures** based on the reinforcement of all cleanliness and tidiness operations, but with divergent approaches: low or high tech;
- **the tactical reorganisation** of the use of station spaces to allow the application of social distancing rules and the creation of routes that involve as little contact as possible. This leads to functional changes in certain service areas in stations and the reorganisation of traveller routes from the station entrance to the door of the train, with the creation of walk-through zones and more laminar flows using queueing barriers, etc.
- **operational adaptations** to maintain a limited and minimal service sometimes targeted at specific users. Some operators concentrate on transporting “front line workers” who contribute to keeping society and the economy running in times of pandemic, while others target vulnerable users such as at-risk populations (age, physical predisposition) among on-the-ground workers and travellers.
- **strategic reorientations** of station development plans including the revision of size and density rules and new partnerships.

Different “profiles” of response can also have a bearing on structural changes and create a knock-on effect on the long-term dynamics of regulation, opening up to competition and the transformation of station services, etc.

### 1. PREVENTIVE RESPONSES: DEEP CLEANING

These responses aim to reduce the risk of transmission and reassure users.

#### **Actions among users:**

- distribution of hydro-alcoholic gel and face coverings
- more frequent and thorough cleaning of vehicles and surfaces
- taking temperatures (staff and sometimes passengers)
- improved ventilation (open windows, etc.)

#### **Actions among staff (some of whom are at risk)**

- appropriate HR management of ground staff, drivers and conductors

Responses can be applied immediately and permanently or on an ad-hoc basis. They fall within the scope of maintenance, cleanliness and supervision of cleanliness. They are deployed on the ground through the usual front-line and management teams, although reinforcements are made. They require varying levels of investment, from the cost of consumables (hydro-alcoholic gel etc.) to investments such as robot cleaners.

### 2. TACTICAL RESPONSES: FILTERING ACCESS AND REORGANISING ROUTES IN STATIONS

This kind of response requires between several days and several weeks to implement. It is tactical because it is based on phased governance of the health crisis (lockdown, release from lockdown, social distancing rules) and responses are therefore reversible and flexible.

In these cases, stations are not closed and **it has been observed that the health crisis made the conditions of access a major focus point for authorities.**

- for flow management reasons: the application of social distancing rules means that stations have reduced capacity and entrances to the station are regulated by the creation of queues on the forecourt or by allocating time slots to users (in some countries, users are allowed to enter the metro in 30mn slots).

- for passenger sorting reasons: who is allowed to access the public transport network? Healthy travellers (with a test) versus risky travellers? Front-line workers versus all commuters and residents without distinction? In Singapore, for example, the *Safe entry* app digitally screens people entering stations using a QR code.

- **definition of boarding routes in the form of corridors and multiple “thresholds”**

- crowd management and pedestrian flow regulation at station entrances and inside stations

- identification of congestion areas caused by bottlenecks: stairs and escalators, lifts, lines of automatic ticket barriers and the creation of laminar flow (queues) using barriers.

- signs on the floor indicating circulation and waiting areas (hall, platforms, corridors, in front of desks or ticket machines, etc.)

- a whole series of tools exists to help manage flows: counting programmes, video tracking cameras, sensors to calculate the number of people (predictive and real-time tools), tools to measure the load and capacity in real time. Up till now, these have been very poorly articulated with the real-time, “hands-on” management of the flow managers on site.

### **3. OPERATIONAL RESPONSES: MEASURES TO ADAPT RAIL TRAFFIC DURING THE HEALTH CRISIS**

Responses developed by public transport providers during the health crisis. The aim is to rescale the service and redistribute resources.

#### **Frequency and scaling of service capacities**

- reduce frequencies
- modify timetables
- reduce the daily service range and redirect capacity to peak times
- reassign services with low and optimised frequencies
- create new services that serve subsets of stations
- change which stops are served

These responses lie within the scope of service production and their period of application is adjusted according to changes in rules for managing the health crisis: certain quarantined neighbourhoods no longer need to be served, unlike other areas of the metropolitan space, and adaptations are made in real time.

Tools must be created to redistribute resources (vehicles, drivers) while maximising user satisfaction and minimising the capacity of each vehicle and the decrease in operators' revenue. Service models typically have two objectives:

- maximise the level of service despite limited resources
- minimise resources in order to achieve a certain level of service

Significant effort is being made to adapt service management tools using software that takes account of capacity limitations and the redistribution of demand (recalibrated) in time and space by three means:

- redesigning the service
- redistributing resources
- redistributing flows

Models based on optimal resource allocation rules (compromises between generalised passenger costs, including the cost of waiting time, and operational costs, i.e. the number of vehicles deployed and the total number of journeys made) are adjusted to monitor the optimisation of train and station crowding reduction. These models must also offer greater flexibility in terms of service variations (virtual “on request” lines, lines with a halfway turnaround, “interline” services to connect interrupted longer lines).

• **Evolution of station flow management models to incorporate the “de-densification” of passengers and the laminar reorganisation of pedestrian flows and queues.** Some software programmes use geolocation and predictive tools to track, screen or discourage “risk” populations from using crowded public transport at peak times (old or young people, BAME (black, Asian and minority ethnic), etc.).

• **Evolution of traffic management software:** these programmes are based on algorithmic models to optimise, regularise and reduce journey times. They are currently being recalibrated to incorporate service reorganisation and limitations on the number of passengers allowed to board.

• **Evolution of models to synchronise connections:** nominal capacities are being replaced by recommended capacities based on social distancing rules to limit the number of passengers per train (although service regularity can also be optimised or vehicle speeds increased).

• **Evolution of timetables:** once based on passenger waiting time, vehicle availability and journey time, timetables are now designed to take account of adapted capacity and reorientate public transport services around the needs of frontline workers: where they live, the number of people per stop, the destinations linked to the jobs they hold, etc.

#### 4. STRATEGIC RESPONSES: WILL “DE-DENSIFICATION” BE A NEW CRITERION FOR URBAN DEVELOPMENT?

Strategic responses are developed in a post-health-crisis timeframe. They are deployed in the post-pandemic phase and prepare for recovery by reconsidering the objectives and means of network planning in the medium and long term. Strategic responses are necessarily designed in a more partnership-based framework and include consultation and participation processes - both in-house within transport companies and externally with urban actors and local authorities - whereas preventive and tactical responses are designed and implemented quickly, with the need for reactivity calling for more authoritarian decision-making.

The first stages are dedicated to adjusting and increasing the network load while maintaining key principles of social distancing. Recovery is not linear but is subject to reversals due to a possible resurgence of the epidemic and lockdown measures. There have also been major long-term changes in the public perception of transport networks, seen as potential infection zones, which requires work to reconcile the public with public transport. To respond to this challenge, transport services must be planned in coordination with the urban authorities because users are sometimes given contradictory advice between urban “lockdowns” and public transport “shutdowns”. What are the priorities?

- maintain high levels of service despite reduced demand for transport?
- discourage users from using the transport network?

- target specific neighbourhoods or users through the adaptation of lines, additional and on-demand services?
- for companies: encourage the creation of company travel plans and communication to transport operators to adapt services?

## 5. MANAGING THE HEALTH CRISIS THROUGH TRANSPORT NETWORKS: “COV-TECH” MANAGEMENT OF PUBLIC TRANSPORT

In the medium term, a major leap forward has been made by transport and urban actors who are acquiring engineering tools (modelling, simulation) to manage the health crisis and can compare approaches more effectively. Urban management tools are also available (classification of the health and social vulnerability of metropolitan neighbourhoods, **heat maps** for tracking the infection). It is certain that the virus travels along the networks. It is possible to combine epidemiological models (potential contact graphs based on individual journeys) with disaggregated transport demand models (agent-based models and activity models).

- the spatial footprint of the spread of the epidemic follows the networks and is partially concentrated around the transport nodes;
- to a large extent, the density of the built environment and the nature of the services in the station areas explain the severity of infection. Multiple inexpensive restaurants near certain peripheral stations are one of the elements explaining the phenomena observed. Closing these establishments has a noticeable effect.

The Hong Kong metro authority is partnering a local biology and epidemiology company to study the hypothesis of the development of clusters as a result of public transport. The circulation of the COVID-19 virus is modelled based on the opening and closure of public transport lines and the density of the built-up area around stations.

The Washington DC authorities are open to the idea of **making the capital's metro a laboratory for post-health crisis adaptation techniques and strategies** and has provided open access to all their data, allowing the Smart Growth Institute at the University of Maryland National Transportation Center to process it and make recommendations for travellers.

By integrating metropolitan traffic data (including public transport supply and demand) and health data (location of clusters, infection dynamics), the urban health crisis can be managed through transport networks and answers can be provided to the following questions:

- what volume / percentage of passengers are likely to be infected given a certain level of public transport activity?
- what level of infection in the population is considered acceptable (or the target) for a certain level of public transport activity?
- how can the transport network be made topologically robust and resilient in the long term: which are the “vulnerable” hubs and stations?
- if these vulnerable stations are closed, what are the effects in terms of reduced employment and training opportunities?

### Based on this type of information, rail and urban planning processes can be reviewed:

- in terms of mobility facility design and rail planning: it is important to reflect on the impacts of social distancing on the definition of new standards for density and the use of railway spaces and vehicles.
- choose rolling stock with greater capacity and less compact?
- dimensions of intermodal spaces: reduce the density of interchanges?
- design and develop spaces that are more flexible to variations in demand?

- in terms of **urban planning**: it is important to reflect on the impacts of social distancing on the definition of new standards for density and use of urban spaces.

- what urban scales and architectural forms of urban density should be used in station areas?
- should decisions be made to close certain undersized stations in the middle of densely populated areas and locate future stations away from highly populated areas?
- should inter-station intervals be defined differently and active mobility be encouraged for short journeys?
- redeploy networks: cut long networks and create "interlines"?

## 5. HEALTHY, SAFE, RESPONSIBLE, SMART:

### FOUR LINES OF COMMUNICATION

To adapt stations to the health crisis, four lines of public communication are focused on:

#### 1. HYGIENIC LINES: THE ULTRA-CLEAN STATION

Messages to the public: "virus-free station" and "deep cleaning": the guarantee of a station experience that minimises the risk of infection.

Asian cities were very quick to adopt this approach because of their previous experience with health crises in public transport:

Once "high-touch" spaces, stations have become (to different degrees) high tech.

**Low-tech example: in Pakistan, "walk-through gates" have been set up, composed of disinfection gates that spray hydroalcoholic gel at station entrances. High-tech example: transition from a socially-distanced station to a contactless station**

Social distancing (flow management) is used to create disinfection routes.

- cleaning staff replaced by spraying robots (spraying and surface cleaning with disinfectant)

- **sensors** instead of buttons (doors, ticketing, lifts, etc.).

- non-intrusive recognition methods

- mass-media communication strategies to reassure the public: partnership with the *South China Morning Post*

#### 2. THE RESPONSIBLE STATION:

##### PROTECTION OF "AT-RISK PEOPLE"

This line of communication is based on equity with the message that public transport reinforces public values: "public transport for public values".

The guarantee is that the operator is taking every measure for the most vulnerable people (i.e. the most at-risk users and staff) and that, in its reorganisation of the service during the health crisis, it is taking account of or even compensating for the unequal effects of the health crisis.



**London:** Publication of a report by a prestigious university (University College London) on the level of exposure of frontline workers in transport professions, morbidity and solutions implemented by Transport For London<sup>1</sup>.

Identification of risk factors: social, racial, health or age-based comorbidity (made possible by the identification of bus, metro and tram drivers according to their spatial, social and racial background (BAME - black, Asian and ethnic minority groups) and health conditions such as hypertension, cardiovascular conditions or diabetes).

### 3. THE SENSOR AND DATA STATION: IDENTIFYING AND FILTERING USERS

**For several years now, there has been a fundamental movement at work: the digital dynamic of smart cities has been “fixed” in and through stations.** The station is a place for the fusion of technologies: credit card/phone, cameras, social media. Using Twitter geotags, it is possible to identify whether people keep their distance and whether they catch the train.

The health crisis has been an extraordinary accelerator for the technological transformation of stations. COVID-19 intensifies the pressure by digital players on governmental and railway actors for the remote and technically mediated monitoring of the public mobility space, including stations. Technological resources are very varied: robotic solutions for hygiene management, COVID contact tracing applications, crowding apps. **In Beijing**, station management is evolving with the generalisation of **non-intrusive techniques for the automated control of users’ identity, behaviour and modes of travel.**

Mass video surveillance is combined with artificial intelligence (deep learning) devices for real-time algorithmic processing. Facial recognition is rapidly developing in public transport spaces (roads and pavements) and is used for traffic regulation.

The aim is to allow surveillance and encourage self-discipline among users with respect to the regulations concerning public transport. Users are informed of density levels in stations in real time and can adapt their route through the station and their choice of line according to real-time crowding information in order to remain below potential thresholds: congestion, infection levels, etc. Certain reminder instruments exist (your phone beeps whenever you are within 1.5m of someone for more than a few minutes or if you stray from a predetermined route set by the smartphone). C.f. Asad, S., Dashtipour, K., Hussain, S., Abbasi, Q. H. and Imran, M. A. (2020) *Travelers - Tracing and Mobility Profiling Using Machine Learning in Railway Systems*. In: 5<sup>th</sup> International Conference on the UK-China Emerging Technologies (UCET 2020), Glasgow, UK, 20-21 Aug 2020.

As explained above, these technological tools can also allow users to make sure they avoid certain “at risk” (or less desirable) population groups at a certain time in a given part of the network. The figures below show the spatial deployment of stations and modelling tools to identify over 60’s, who are more vulnerable to infectious transmission, within the massive flows on public transport at peak times.

**The corresponding line of communication is based on the position of “public” actors of public transport to guarantee compliance with the legal requirements of monitoring and surveillance and, depending on national regulatory frameworks, propose (or not) in-station images with separate gates.**

## 6 - REBUILDING CONFIDENCE IN PUBLIC TRANSPORT

In the context of the Covid crisis, large metropolitan areas are associated with an underlying sense of social anxiety, which explains why they have become repulsive. Changes in behaviour and the way public transport is represented are taking place. A certain psychological insecurity that is, to different degrees, conscious and expressed has developed among the population, based on the fear of intrusion into one's personal space of physical protection. Stations and public transport are increasingly central to the daily landscape of this insecurity. In public transport, the tolerance threshold for proximity has dropped considerably. It has gone from around 20cm to 1m. Fears crystallize around public transport and the need to use worrying public space, crowded stations that have been reorganised in terms of flow management (visibility conditions, signage, management of waiting in different queues, etc.). The idea, strongly defended by railway actors, of the station as a space that is perfectly open to the city and is socially desirable and conducive to peaceful and good-natured mobility and otherness (piano playing, etc.), is undermined by everyday experience. The decline in public transport use and the number of people in train stations can be viewed as the expression of forms of divergence from the proposed conventions of mobility and metropolitan consumption.

These fears, forms of mobility and the use of public space based on diversion, avoidance and the fear of others, can slow the return to the use of metropolitan mobility systems and economic recovery during the post-pandemic phase.

The fear of proximity to others and anxiety based on the fusion and confusion between security fears and health fears, must be taken seriously. Otherwise, forms of mass avoidance of public transport may develop among metropolitan populations looking for "non transit commuting trips".

Organising authorities and urban transport actors are faced with the challenge of rebuilding a relationship of confidence and the promise of ease, and transforming the popular representation of stations and interchanges from infrastructures of fear into infrastructures of care.

This can be done in four ways:

- combining infodemics and traffic data and supplying them to users through real-time navigation tools in stations, to allow them to manage the risk themselves and make their own decisions about whether to avoid dangerous areas and how to "negotiate" distances from other people and modes of circulation;

- guaranteeing the legality and transparency of this data and the conditions in which users consent to the tracking of their journeys and the modalities of normative monitoring;

Organising public transport facilities around care, health and sustainability (respecting hygiene in stations, testing in stations, how to best spend time in stations).

- reaffirming the individual dimension of mobility needs, in the name of the collective values of public transport.

## **1. INFODEMICS AND TRAFFIC DATA: CONFIDENCE THROUGH EMPOWERMENT AND AUTONOMY OF THE "AUGMENTED CUSTOMER" IN THE STATION**

**Surveillance technologies for monitoring the territory and transport networks are merging.** Countries are caught up in the contact-tracing race and the station becomes a tool for the metropolitan management of the health crisis because:

- it is one of the busiest urban spaces
- it is one of the easiest places in which to produce health data, infodemics or epidemiological data that specify locations, target infection groups, patterns of spread

- it is one of the places where rapid and proactive approaches can be developed (to limit flows, identify travellers)
- it is one of the places in the city where such individualised information can be stored and processed.

Combining technical tools for tracking metropolitan travel in order to monitor metropolitan functioning during a health crisis requires a high level of coordination between **health crisis management organisations. In China in particular, cities have seen the development of integrated health monitoring centres in which travel data within the public space and traffic data from public transport networks are collected and processed together.**

For Asian metropolitan populations, particularly those near large international markets who have not only experienced pandemics in recent times (SARS, MERS) but also in the past with epidemics caused by trade during the colonial periods (Spanish flu in particular), the shift in urban government to a health crisis mode generates confidence in society. A virtuous cycle is created. The health crisis reinforces accustomation and the social acceptance of remote station monitoring tools. These new tools allow mass surveillance of urban mobility and are not necessarily seen, like in the West, as depriving citizens of liberty.

Massive data produced in stations can be “returned” to the station users who, after all, produce the data through their own movements. By using data on the following via a smartphone:

- building geolocation
- traffic prediction
- real time crowding

(three smartphones below) users can be "more autonomous and responsible for their choices". This data allows users to choose their mode of transport and itinerary in real time. They feel they are “regaining control” by consulting the level of crowding in the network in the morning and deciding which line to take.

Ultimately, the construction of confidence lies in the construction of the loop between contextual data production, management and processing, and its consumption or self-consumption by "augmented" users who can instantly manage their own route through the public space, stations and their surroundings. The quality of the information and the conditions of its production and processing must be guaranteed: the guarantee of transparency is an essential aspect of this relationship of confidence.

## 2. CONFIDENCE THROUGH MORE TRANSPARENT MONITORING

During a health crisis, stations are places in which transport, urban and health authorities meet together in crisis control centres and organise additional monitoring and generalised mobility tracking.

These tools, which were once focused on techniques for counting and optimising flow circulation, are now orientated towards recognising “at-risk” behaviour and identifying miscreants.

The creation of confidence requires greater transparency in the conditions of data production, algorithmic processing methods, the duration of storage of circulation data and types of user identification, as well as specifying types of deviance (health, security) that are targeted by these tools.

There are numerous, multidisciplinary challenges:

- regulatory challenges
- ethical challenges (respect for privacy)

- governmental control of the informed consent of public transport users to submit to these modes of surveillance.
- effect on privacy
- duration of storage of individual information (journeys, duration)
- sharing of smart station technologies between public operators (state or local)
- ownership of data, ownership of software tools between public and private actors

### **3. CONFIDENCE THROUGH THE CONFIGURATION OF PUBLIC TRANSPORT AS AN INSTANCE OF COMPREHENSIVE CARE FOR INDIVIDUALS IN A CARE-BASED RELATIONSHIP**

COVID intensifies the fear of others and crowds in public spaces. It has been shown in several cities around the world that it accentuates “racial” terror and panic reactions in crowds faced with deviant behaviour by an individual. These reactions reflect the psychological orientations of individuals but are also based on representations and connected to opinion “bubbles” in groups (community, cultural, local, etc.). Numerous studies show that increasingly "agoraphobic" behaviour is linked to the structure of users' social networks (insular, reticular, etc.). There are also already forms of interactive management with target populations through social media to build confidence around using public transport.

Here, institutional partnerships set up by transport authorities with health operators and major media players can play an important role. In China and the UK, transport authorities collaborate with health institutions (similar to the Institut Pasteur in France) and public or private media players (such as the partnership between the Hong Kong transport authority and the *South China Morning Post*).

In France, COVID test sites are being set up near major stations and sometimes inside the stations themselves where there is space. This could be the beginning of a new way of interacting with users in which the station is presented as a reassuring environment and the site management staff as a group of actors dedicated to helping them learn new ways of experiencing and moving around stations with confidence.

Stations during COVID are 1-m stations. They are a whole series of behaviour rules, actions to take, signs to follow and routes to take, creating a longer, less smooth and perhaps more difficult customer journey. Social distancing creates new behavioural “rules” in stations that should be a source of reassurance, not more apprehension.

### **4. CONFIDENCE BY REAFFIRMING THE PUBLIC VALUES OF PUBLIC TRANSPORT, I.E. RECOGNITION OF INDIVIDUAL SPECIFICITIES IN ADAPTING TO NEW THINGS TO LEARN ABOUT COLLECTIVE MOBILITY**

Messages about the application of social distancing rules are "universal" but their reception is always particular. Little has been done to understand the determinants of the psychological and socio-cultural aspects of the (relative) acceptance of social distancing and the new control and surveillance norms in stations and the busiest urban public spaces. Authoritarian and paternalistic forms (exclusion, punishment) are not enough.

Social distancing rules are applied according to psychological (and therefore individual) biases as well as cultural and collective understanding transmitted through family circles or social contacts (at school, work, etc.).

- willingness to wear a face covering, repeatedly use hydro-alcoholic gel
- willingness to wait in a line a metre away from the person in front before entering a station, train, etc.
- apprehension about going through different health, anti-fraud or security filters, depending on the person.

To rebuild a relationship of confidence, explanations are needed: these actions and norms are all linked to the fact of building collective health security, not protecting oneself but everybody else. However, railway stations are places of "weak social ties". Are users willing to make the effort to protect others, or to protect the transport system? What are individuals' levels of tolerance to these new "burdens" in the "classic" journey through the station? What happens to satisfaction, comfort, confidence and stress in the station?

In some cities across the world, transport authorities are adapting marketing tools to accompany and encourage the return to crowded public places such as transport facilities. According to the target audience (young people, elderly people at risk, daily commuters), they translate and adapt these new values of order in stations (compliance with social distancing rules) with values of respect, tolerance and reciprocity.

They carry out profiling in terms of individuals' response to regulations and transport connectedness (the ability to forge contacts during transit or in transport facilities, depending on whether the rule comes from outside (grid) or from restrictions that have been internalised by the group).

Broadly speaking, there are four approaches to compliance with recommendations:

- hierarchical: the user follows the rule because it is there
- egalitarian: the user follows the rule because everyone else does
- individualistic: the user follows the rule to protect their own health and continue travelling in the future
- fatalistic: the user follows the rule but does not think it is effective

Some actions are therefore better accepted because they make sense with regard to the idea of protecting the community, while others are more easily enforced in the framework of accepting rules and regulations. It is important to tailor messages to individuals' social ties, their perception of the social "good", their level of altruism and receptiveness to horizontal injunctions (of the group to which they consider themselves to belong, their own identity) and vertical injunctions (the regulatory norms in force), in accordance with psycho-social profiling. Transport actors are developing "emotional" steering tools based on the expression of public transport values and ethics. This type of profiling can inform the actions and attitudes of station management staff, including security staff.