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### Abstract

The COVID-19 pandemic has the highest impact on aviation since World War II. Airlines and airports struggle together with passengers, cargo and even legal bodies and governments. But where to start from to understand the dynamics of the impact of our subject at TxP\_R: air terminals? Starting in the middle of March, when the pandemic had arrived in Italy but Europe was still on business as usual. We followed the shutdown and measures set-up at the airports mainly induced by public health authorities. The reaction at air terminals was as inhomogeneous as were the national health instructions. To prepare the path for a slow-reopening and possible future situations we started gathering information on the specific measures at European capital city hubs, the European legal guidance and supportive actions and documents of the stakeholders involved at a European and international level in aviation. The paper represents a working stage on April 28th 2020 seeking to support researchers and authorities with gaining an overview of the status quo.

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# Defining guidelines for European air terminal adaptation to COVID-19 measures

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# Defining guidelines for European air terminal adaptation to COVID-19 measures

## Introduction

Being specialized in air terminal design and management support the TxP\_R work group at the University of Florence, Italy, started capturing the difficulties in responding to the impact of COVID-19 at an early stage. In March we decided to analyse the measures mainly at European airports and the extra European hubs that looked most promising for lessons to learn. To better use our capacities, we selected the European capital city airports, EU and non. Even though these airports aren't the ones with the most traffic in their countries, at least one for each capital was supposed to stay operational. In addition to this all ministries and organizational bodies are directly linked with these airports. Therefore we expected them to be amongst the structures implementing required measures first and being linked close enough with national authorities to serve as test-fields, if required.

To understand the measures taken we decided to search the airports homepages for COVID-19 (mainly English versions, some with translator, for Chinese not available) information and operational news. The results underlined what we suspected from our conversation with operators at Italian airports: <sup>1</sup>

The airline activities were reduced heavily at that time in Asia, most European member states and Switzerland. Israel followed. Small airports started to be closed for lack of traffic larger ones reduced the served terminals mostly using a single terminal. Using the most recently equipped terminal buildings and connected car parks helped with reducing the contact points between passengers and personnel. The WHO induced hygiene and health protocols are implemented well in terms of cleaning and disinfection methods. Mask order was impossible because of missing material at that time. This situation has become a little better today, but with some countries still starting to implement measures the market will need more time to recover. Today only staff can be provided with masks in most airports, Passengers have to provide their own devices.

The most difficult measure to be implemented was social distancing. The differences in social distancing in normal life are very much linked with people's cultural background. It may be easier to understand thinking of the Japanese greeting ceremonial, the northern European handshake and the southern embracing with kisses. The closer the natural behaviour codex, the more difficult it gets to understand a distance of 2m between passengers.

### Distance to keep from other persons:

Table 1: Distancing at Airports (by IATA code) <sup>2</sup>

1m	CDG, ORY, FCO, CIA, MAD
1,5m	VIE, AMS, TLL (1,5-2 m)
2m	FBB, TXL, DUB

This is what we encounter on streets and in shops. But air terminal design is developed following and guiding passenger flows based on a "normal" distancing. How should these paths be adapted in this situation with potentially infected passengers, external health and safety personnel operations to be integrated into airport procedures. Facing panic amongst the personnel for the risk of infection, the reduction of passenger flights to emergency contingent and therewith to revenue collapse. While a large number of parked airplanes had to be handled without having clear information on European

rights for charging these aircrafts parked because of legal shutdown <sup>3</sup>. Not to consider freight carriers changing their concepts as 50% of freight is usually carried by passenger flights. Cargo handling and the implications between passenger and pure cargo transports is an extremely complex subject in itself and its development under the effect of COVID-19 will have to be discussed elsewhere. At this point we would just like to mention, that cargo being considered as essential service has lead to one of the first European COVID-19 guidelines<sup>4</sup>. But this may illustrate the complexity of handling air terminal management in the uncertainty of daily changing legal frameworks at a national and international level. I.e. it was not one situation to adapt to, but continuous flexibility in measures and space was required.

Table 2: Non EU country airport shutdown between March 25th and 29 2020 <sup>5</sup>

Measure	Airport	Update March 29
Full airport Shut down (commercial flights)	TIA (only one connection with Istanbul remaining), IEV, SKP	LCY (from 26 March), ESB (from 29 March), SAW (from 29 March)
Reduction of terminals	SVO, KBP, LGW	
Domestic travel only	OSL, BEG	SAW (27-29 March), ESB (27-29 March), IST

TxP\_R tried to find some common approach to the reaction within the different realities at the airport. In this context became clear that, as encountered with many other projects, that the air side of the airport organization was the first to react, so that most reductions of terminal activity was due to the reaction of airlines to the continuously growing number of bans expressed by the governments. The airlines were no longer able to foresee the connections open for service not even a few days in advance and tried to block as soon as possible parking slots for their planes. One by one low cost carriers and smaller airlines reduce their active fleet to a minimum or closed completely. By today even most national airlines closed down to emergency flights only. The early chary news on reopening will expected for the beginning of May 2020. Extremely chary if to say, that e.g. United Airlines expects to operate with their whole fleet 4 passenger lines between the US, Asia and Europe. Whereas AA carrier already transformed 20 passenger aircrafts into a small fleet of freight carriers.

Commercial activities are closed down apart from basic support like take-away food, pharmacies, bank services etc. Between March and the end of April 98% of European passenger flights are cancelled. The airports reacted in different ways but there was not yet much time to search for good examples.

Table 3: Additional measures taken at European airports <sup>6</sup>

Measure by March 25 (not adopted elsewhere by March 29)	Airport
Airport quarantine facility enlarged	ATH
Information point Corona	FCO, CIA
Simulation of infection case at beginning of crisis	VON
Water tabs to fill empty drinking bottles	AMS
Parking cancellation for free/1 year valid	AMS, CDG
De-boarding long haul slow down for distancing	ZRH

Shuttle distancing check	ZRH
Specific exit/baggage belt for high risk flights	VKO
Passport control for high risk passengers	VKO
Redirection of ground traffic access	LGW
Seats in waiting areas sealed for distancing	SAW
Terminal pier area as isolation Clinique	LHR
Shuttle distancing check	ZRH

Praveen Duddu published a short summary on international airports involved in COVID-19 already on March 26<sup>7</sup>, which may show the perspective of the early stage of the pandemics.

The study of how airport management and national authorities reacted on the outbreak of the COVID-19 pandemic indicates the problems likely to be encountered in the future reopening of air terminals, if no clear (common) strategy will have been developed and put in place by that point in time. Even though we do still not know for certain when the reopening will take place, nor which airlines and which smaller airports may be in danger of bankruptcy, we do know, that the reopening after the worldwide pandemic will pose a managerial hurdle of extraordinary dimensions in terms of economic, managerial and human effort. For at least the upcoming two years it is expected to require specific protective measures and even after that some impact will be seen in physical airport planning as well as managerial procedures.

## Events with severe impact in the past – lessons to learn from

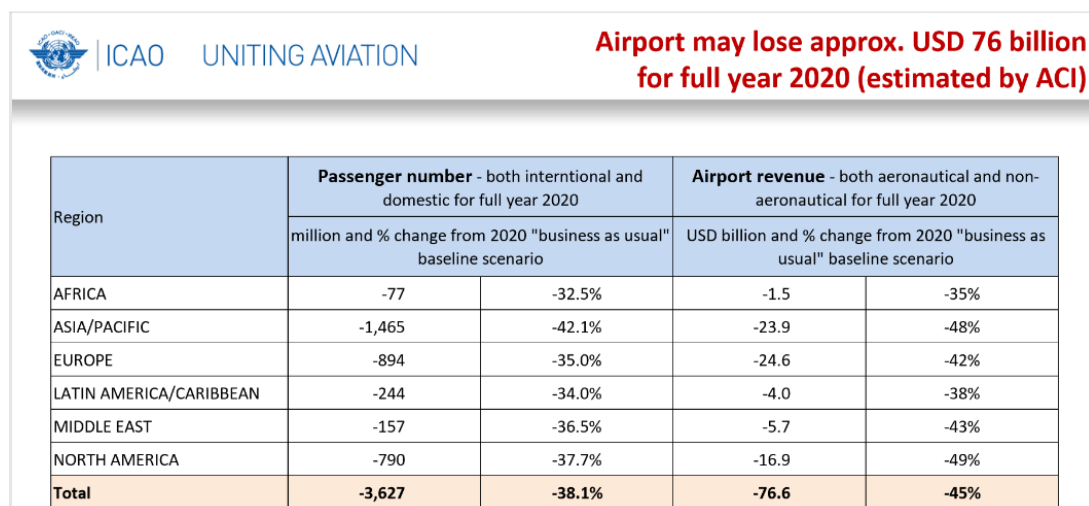


Figure 1: Estimation passenger load and airport revenue reduction due to COVID-19 from March 2020<sup>8</sup>

There are some exceptional experiences we can refer to in predicting the impacts, even though there has never been this heavy impact all over the world before.

1. In 2010 there was the largest air traffic shutdown since World War II due to the eruption of Iceland volcano Eyjafjallajökull. But this event lasted for about 10 days requiring flexible shutdown strategies for other to weeks along the path of the ash cloud. This led to an almost

complete shutdown (90%) over Europe and North America. The closures caused millions of passengers to be stranded not only in Europe, but across the world. A second eruption of an other Icelandic volcano in 2014 called for caution but had a short term impact only on a few route deviations.

IATA Director General and CEO Giovanni Bisignani stated: “At the operational and technical level, we quickly discovered that we are ill equipped to deal with such situations.”<sup>9</sup> He especially highlights the problems that occurred with following the cloud and implementing measures on the basis of Europe’s “divided sky”. He estimates the loss for aviation industry at US \$1.7 billion. ICAO (International Civil Aviation Organisation) estimated £80 million loss for airports and flight cancellations of about 100.000 and 10 Million interrupted passenger journeys. Corona is expected to cause a loss of \$27.8 billion for the carriers alone.

Europe and the international authorities reacted as described by Celso Figueiredo<sup>10</sup>. The eruption of volcano Eyjafjallajökull in 2010 caused significant disruptions to the European air transport system and triggered the setup of an international task force to develop new global provisions:

- New template for the VACPs, EUR and NAT Regions of ICAO’s common Volcanic Ash Contingency Plan (VACP)
- The new Volcanic Ash Contingency Plan – North Atlantic Region (NAT Doc 006 Part II) was effective from November 2014; This meant a transfer of responsibility regarding the decision to operate into an area of known or forecast VA contamination from Air Traffic Management (ATM) to Aircraft Operators (AO);
- In 2015 a Volcanic Ash Task Force was established (2015 EUR/NAT VATF) between EUR and NAT Regions to agree on a common version.

These measures lead to reduce efficiently the impact of the second volcano eruption in 2017. Lessons to learn result from the plans for re-opening following the dynamics given by the ash clouds. These dynamics requested preparedness for reopening to flexible slots and flight connections as well as measures to guarantee additional shut downs on demand. It also helps to understand the dynamics of recovery from complete shutdown situations.

2. The attacks on the World Trade Center and the Pentagon in the US on **9/11/2001** impacted not only on the security systems of the whole western world, but also on passenger experiences and security systems of all airports. The new security measures required specific procedures, new technology for metal and liquid detection and personnel control up to different procedures for baggage and freight handling, video monitoring etc. The US shutdown following lasted for two weeks. After that the timeline for reopening became clear and as industrial production was not impacted freight restarted even recovering the time lost and passenger travel restarted a little reluctant. Business as usual was reached after 9 months. The fact that 50% of freight is carried by passenger flights helped with economic balancing.
3. The epidemics **SARS** (May 2003), Avian Influenza (2005) and Influenza A-H1N1 (2009) which induced the introduction of several passenger examination methods, handling procedures and a health related communication between the players which had not been possible before even because of the state of communication technology at that moment in time.



Figure 2: Dr Anthony Evans , “Influenza A(H1N1) and the aviation sector“<sup>11</sup>

The heavy international impact of H1N1 finally led to the integration of emergency requirements for pandemics to come. Thus between 2007 and 2009 the ICAO states integrated a specific pandemic preparedness plan for aviation into their national emergency plans.

They included following procedures and devices:

On board:

- Cabin crew advice on how to identify a suspected case (changes to aircraft declaration)
- Passenger locator card for contact tracing agreed by WHO (collaboration with IATA)
- ‘Universal precaution kit’ for managing on board communicable disease
- Pilot in command in charge of notifying air traffic control of a suspected case (before only communicated to airline!), this led to a substantial speed-up allowing related parking allocation and accompanying health authority readiness.

Whereas for airport screening:

- The Health declaration card
- Temperature measuring devices:
  - Infra-red imaging
  - Temperature probe

Even though screening was not recommended by WHO for H1N1 it was considered as possible disease surveillance tool.

Emergency procedures to guarantee a smooth line of communication (The significant disruption had formerly caused a delay of >24 hours) were introduced.

Already during the H1N1 pandemic it occurred, that one of the few available screening devices was temperature screening, which identifies passengers with fever. WHO pointed out, that fever was not a common symptom for all infected individuals, but as there was no method to detect fever free infected persons there was no further sensor introduced. This is a problem we encounter again with COVID-19. ECDC<sup>12</sup> does not judge temperature measurement as valid means for infection detection, because of the long median incubation period of 5–6 days for COVID-19, with a range of 1–14 days; but WHO underlines the positive psychological effect of visible measures against infection, which should not be underestimated though in terms of reassuring all passengers on encountering the maximum level of safety the



institutions are able to provide and also the effect on infected persons avoiding travel because of this.

Even the economic impact illustrated for the first time after World War II that external circumstances would make the worldwide aviation system vulnerable.

## COVID-19 – a situation never experienced before



Figure 3- 6 Impact of past pandemics on air traffic <sup>13</sup>

To understand the difference to COVID-19 it is enough to know, that “at the height of the outbreak (May 2003), monthly RPKs of Asia-Pacific airlines were ca.35% lower than their pre-crisis levels, [...] monthly international passenger traffic returned to its pre-crisis level within nine months.” <sup>14</sup>

Whereas by the beginning of March 2020 IATA already estimated a drop of passengers of 23-24% in all countries which reported at least 10 cases at that moment in time. <sup>15</sup>

ICAOs latest publications on COVID-19 impact <sup>16</sup> suggest two scenarios based on a reopening from May and an other one starting in the 3<sup>rd</sup> quarter of 2020 or later. The one estimated with a potential loss of USD 160 to 218 billion the other estimating even USD 218 to 253 billion.

After the analysis of the preceding major events it becomes evident, that COVID-19 impacted in a never yet encountered way on Air traffic worldwide. Therefore the effort on developing measures for pandemic impact reduction in every area of social life is extreme. Airports have already in the past been considered as focal points for pandemic distribution. Therefore the impact on COVID-19 measures on aviation protocols and procedures of passenger flows, transfer and safety are expected to change permanent practice in the future.

The lessons learned from the events in the past are the:

- Health protocols and fast international implementation procedures for pandemics (valid for aircrafts, more difficult for terminals and modal shift)
- Need for international co-ordination. Even though the airport measures have been differentiated within the European Union, it has shown that the co-ordination worked in a more co-ordinated manner than e.g. with the Eastern European and other countries. Part of this is due to emergency plans developed e.g. after the eruption of 2010.
- The strong economic impact on aviation is due to the pandemic and the related political measures. Air cargo is seen as essential element to support the continuity of provision of goods and thus supported in terms of fast change to directives and orders for state relevant orders. Whereas the passenger transport is initially used for transporting travellers to their

home countries and after this it is shutdown. But the home-countries of the national air carriers are prepared for financial support actions in a co-ordinated manner, even because of the lessons learned during the volcano outbreak. Europe's slot allocation procedure has been one of the first EU directives to be adapted to the situation already on March 13, right away amended to make the EU Single Sky more flexible on demand by introducing the temporal, not eligible grandfathering rule. Non utilised slots are returned to the coordinator (Eurocontrol). Returned slots are subsequently reallocated to other air carriers, without rendering the operating air carrier eligible for grandfathering. I.e. the slot I allocated to a new carrier for a specific trip or period, without inheriting any further rights at European or national level in the future<sup>17</sup>

In April 2020 air traffic mainly consists in cargo, but it should not be forgotten, that 50% of freight is usually carried by passenger flights. Without these flights thus an additional problem will appear with the first harvest of the year and the perishable's transport supply chain is no longer in place. To meet the lack of cargo capacity at the moment some passenger planes are converted to cargo offering a capacity of 1 ½ of typical passenger flights each and also old cargo planes that became not economic have been reactivated. So even if we focus on air terminal operations and passengers it is not to be forgotten, that passenger flights also carry freight, which has to be handled on the airside of the airport, but is stored in contact with baggage on-board the aircrafts.

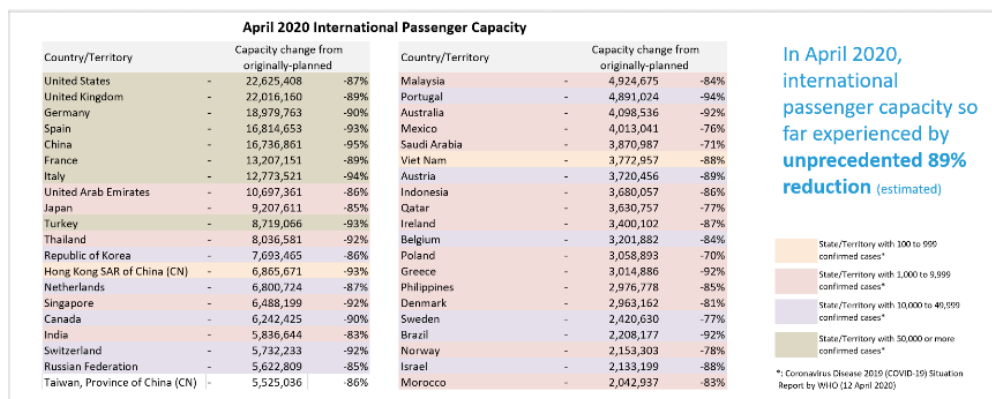


Figure 4: Estimated reduction of capacity by country from March 2020.<sup>18</sup>

## Basic documents of COVID-19 handling in air terminals in April 2020

Several binding guidelines are at the basis of current COVID-19 measures. In the following we summarize the contents interpreting the differences in implementation within the analysed airports.

As aviation is considered the major distribution channel of infection across the world today, the first input on avoiding infection is given by the WHO.

### WHO<sup>19</sup> Operational considerations for managing COVID-19 cases or outbreak in aviation (version March 18 2020)

While concentrating on awareness rising protocols WHO requests “medical face masks to be reserved for persons with respiratory symptoms (and who can tolerate them) to avoid contamination to others.” To understand the speed of the psychological and immunological development it is interesting to affirm that due to medical face masks scarcity by April 2020 many European countries require at least home-made face masks for each passenger in all public transport modes.

The major focus on awareness rising lists:

- Awareness rising and training on COVID-19 symptoms, transmission, hand hygiene and how to handle protective equipment awareness is up to Airport operators, aircraft operators, airlines, and airport (WHO offers material in several languages on their website)
- Personnel in close contact with symptomatic persons (e.g. when providing first aid) should wear a medical mask, eye protection (face shield or goggles), gloves, and gown.”

For crew and ground staff working or staying in areas where local or community transmission is being reported: “<sup>20</sup>

Table 4: Summary of measures<sup>21</sup>

Advice	Measure
Be familiar with local protocols for the reporting and management of ill travellers and their possible contacts	⇒ Information boards on procedure and contact persons/offices
Take precautionary measures to reduce the possibility of infection:	
Avoid rush hours in public transport and use private transport when possible, minimizing contact with other people while moving between the airport and ground transportation.	⇒ Training and/or information / changes in shift allocation
Minimize time spent in public areas, applying social distancing whenever out in public by maintaining a distance of at least 1 meter (3 feet) from other people. (1-2m guidelines apply in different countries)	⇒ Information on screens and posters; distancing lines on ground also for staff (e.g. security check); protective screens for document control, information, check-in, gate, lost & found ⇒ Special protective solutions where not possible (handicap, children, narrow spaces) ⇒ Slow down cues etc.
Wash hands frequently with soap and water or use an alcohol-based hand rub if hands are not visibly dirty.	⇒ Disinfectant provision for passengers & service ⇒ Innovative solutions/restrictions for access to bathrooms, lifts, staircases, passenger boarding bridges, busses, door-gates etc.
Avoid touching eyes, nose, and mouth	Advice only (behaviourism does not guarantee success)
Self-monitoring: If you develop fever, cough, or difficulty breathing, immediately isolate yourself according to local health procedures, wear a mask, report the situation to your employer, and	⇒ Regular advice for self-monitoring and monitoring of colleagues.

seek medical attention.	
The aircraft operator or airline concerned should report it to the local health authority immediately.”	⇒ Information boards on (local) procedure, responsible colleagues and contact persons/offices

For suspected cases operators are referred the framework of the State airport public health preparedness and contingency plans in coordination with airport health authorities as outlined in WHO guidance document on the “Management of ill travellers at Points of Entry – international airports, seaports and ground crossings – in the context of COVID-19.3”<sup>22</sup> and also to be managed in accordance with ICAO Annex 9 (Facilities required for implementation of public health measures) and the aerodrome emergency plan (ICAO Annex 14 developed by the CAPSCA initiative (Collaborative Arrangement for the Prevention and management of public health events in Civil Aviation)<sup>23</sup>, coordinating the response with all agencies that could be of assistance in responding to an emergency.

The WHO guidance on management of ill travellers defines the following steps to be handled:

1. Detection of ill travellers; (by staff, not indicating if airport/health authority);  
Airports are requested to have at least one healthcare worker on site, with adequate equipment, who is designated to support staff in case they encounter ill travellers or cases of suspected COVID-19 disease that require urgent clinical care, detection via self-reporting, visual observation and temperature scan, where available;
2. Interview of ill travellers to determine the possibility of symptoms of and exposure to the virus responsible for COVID-19 disease;  
Airport staff is in charge of accompanying the person showing symptoms to a dedicated physical structure for further assessment and interview.
3. Reporting cases with suspected COVID-19 infection;
4. Isolation, initial case management and referral of those with suspected COVID-19 infection.

Thus the responsibility of co-ordinating suspected case handling is due to airport health authorities following the WHO guidance, whereas ICAO focuses on aviation body responsibilities. To find out about who is in charge, we analysed the other publications named. As the procedure for reporting and detection is already in place at operating international airports, TxP\_R takes the guidance into account in terms of additional material and space required for in depth interviews, airport staff training and allocation and thermal detection device requirement.

### **ICAO Annex 9, Chapter 6, “Convention on International Civil Aviation”<sup>24</sup>**

ICAO clearly assigns the responsibility for ensuring the maintenance of public health at international airports to the single contracting states as responsible, in cooperation with airport operators. I.e. the state is responsible, airport operators are support.

As recommended practice facilities and services for vaccination or revaccination and for the delivery of the corresponding certificates, at or near all their major international airports are named as well as access to appropriate facilities for administration of public health and quarantine measures.

The contracting states are also responsible for ensuring that passengers and crew in transit can remain in premises free from any danger of infection and the provision of facilities for the transfer of passengers and crew to another terminal or airport nearby without exposure to any health hazard.

The contracting states are in charge of co-ordinating and setting up the framework for:

- Handling and distribution procedures for consumable products (i.e. food, drink and water supplies) on board aircraft or in the airport are in compliance with the International Health

Regulations (2005) and relevant guidelines of the World Health Organization, the Food and Agriculture Organization and national airport regulations.

- Safe, sanitary and efficient system is instituted, at international airports (in cooperation with airport and aircraft operators)
- Removal and disposal of all waste, waste water and other matters dangerous to the health of persons, animals or plants, in compliance with the International Health Regulations (2005) and relevant guidelines of the World Health Organization, the Food and Agriculture Organization and national airport regulations
- Maintenance of facilities and services for first-aid attendance on site of international airports, and appropriate arrangements available for expeditious referral of the occasional more\_serious case to prearranged competent medical attention (in cooperation with airport operators)

I.e. Airport authorities are executing bodies and should be consulting the state institutions in charge.

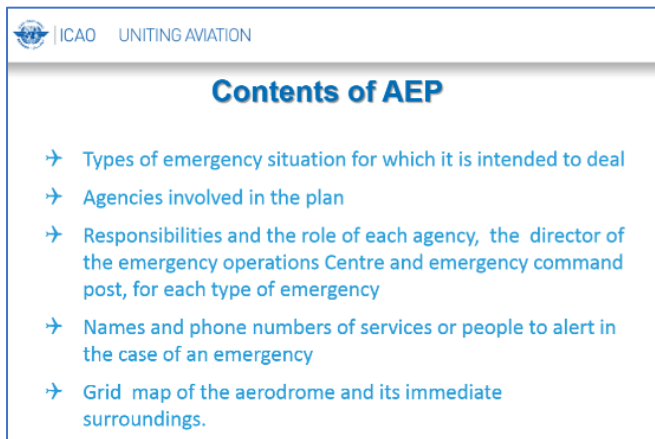


Figure 5: Contents for ICAO aviation emergency plans

## ACI – Airports Council International

To support airport authorities and the preparation for reopening the association ACI (Airport Companies International) published on April 4<sup>th</sup> 2020 general guideline on “Airport Operational Practice - Examples for Managing COVID-19”<sup>25</sup>. It includes the first indications related with management issues. It consists of a to-do list for measures by functional area and distancing for all actors at stake including airport and airline staff, passengers and services suppliers.<sup>26</sup> The guideline is set up as general aid for the formulation of specific national guidelines such as the Chinese CAAC (China Administration of Civil Aviation) guideline published on the basis of ICAO indications before the ACI paper.

The guideline defines an extremely useful framework, but it still requires major issues to solve including:

1. The distancing of 2m requested by ICAO is impossible to be implemented in Europe’s airports, where often even a 1m distancing requires a 50% cut in admissible passenger flow. This lead EASA to the directive to use masks where distancing cannot be guaranteed;
2. Masks and other hygienic material as requested by the guidelines is still extremely difficult to retrieve and cannot yet be guaranteed for the reduced number of personnel
3. Many countries start to oblige passengers in all types of public transport to wear at least homemade masks, but WHO / EASA did not define this type of masks as sufficient for the purpose in airports.

4. Thermal scanning has been indicated as obligatory for reopening for incoming as well as outgoing passengers. Whereas outgoing passengers all pass the relatively spacious areas of the airport atrium, incoming passengers can be measured by national authorities only after document check, passing afterwards relatively narrow paths until the baggage claims. Thus the only possible places for scanning are directly before passport control (highly preferable), at the entrance of baggage claims or directly before customs and exits. Which all pose problems on the one hand because infected persons would pass parts of the path with all other passengers, on the other hand for the lack of space and the connection with health services.
5. It has not yet been cleared who will be responsible (practically and economically) for health checks and security for infectious diseases management in the future nor until when these measures are expected to be implemented and/or which would be the measures to hold for business as usual.
6. A major problem is posed by distancing in narrow services e.g. lifts, restrooms and hand washing devices. Almost no restroom has distinct entrance/exit systems, doorsteps are narrow etc.
7. There are yet no solutions for handling vulnerable groups, passengers requiring support for the full range of the travel, children (distancing), Passengers and aircrafts arriving from high-risk origins (indications change from guideline to guideline), inadmissible persons and deportees.

## **EASA – European Union Aviation Safety Agency**

EASA reacted on social distancing requirements in its “Safety Information Bulletin Aerodromes”<sup>27</sup> taking into account that social distancing does not appear possible everywhere in existing European air terminals. Therefore they precise: “to ensure social distancing is practiced at all time, especially during check-in, security check, pre-boarding, boarding and disembarkation procedures, as well as passport control, where applicable. Where social distancing is not possible, the use of face-masks for the passengers should be considered as an alternative.

The only national agency that has currently set up national guidelines is the Chinese CAAC<sup>28</sup>. Being the first country coping with the disease on a pandemic level they were not able to rely on international guideline development. Therefore their centralized government formulated interim guidance updating it when required. The fourth version of this national guideline (03/04/2020) takes into account the ICAO (United Nations specialized Organisation for International Civil Aviation) guidelines finally available to their needs and based in large parts on the former CAAC. On April 10 CAAC adds a further paragraph on imported cases. On 27/04/2020 IATA indicates these guidelines still as the only ones on airport measures available at this time<sup>29</sup>.

Some of the new measures will become stable infrastructure whereas others may be implemented only during the acute phase of COVID-19. I.e. to plan future hubs, we have to distinguish at least three steps within the back scaling to full airport functionality:

1. Measures at airports that have never been closed (status quo)
2. The reopening phase which will probably start with connections at a limited number of operating flights;
3. The phase within the expected 2 (currently estimated by RKI Robert Koch Institut, Germany) remaining years of pandemic impact;
4. The long-term impact of the pandemic preparing the airports to a possible next wave or outbreak of other pandemic incident occurring.

The lack of detailed specification and the delay between setting up guidelines for aircrafts and terminals reflects the usual focus on airline and air traffic support at airports. Most R&D measures focus on supporting airlines and on rise the throughput to enhance traffic. The incidents of the last 20

years brought to security and monitoring projects and airport enlargements and security check intensification as well as economic impact of commercial exercises at the airport lead to passenger flow and direction efforts. Whereas the health incidents mentioned above require the formation of new alliances to develop and implement measures inside the terminal. TxP\_R works in this field right from the beginning of this process not hesitating to point out the necessity of inter-disciplinary research. But until now, this kind of research has not been integrated into funding schemes on aviation, even though the latest European transport research programs may suggest opportunities.

In addition to this, airports today are no simple hubs where people arrive just to hop on a plane. Many airports have become satellite commercial centres including commercial activities, restaurants and hotels up to shopping malls frequented without any connection with a flight to catch. These specific transport nodes are surrounded by industrial areas and services for passengers, office buildings and factories, shortening the distance between the domestic site e.g. of multi- and international businesses and companies. Measures will have to take this into account.

## Conclusions

The major tasks in air terminal management to be confronted at the moment the:

- Uncertainty on of COVID-19 pandemic development, which leads to
- National regulation adapted on an almost weekly basis, which leads to
- Lack of legal frameworks for implementation plans for the landside of airports
- The uncertainty of the timeframe of measures and restrictions, defined for weeks and often prolonged for months;
- Ground personnel including terminal management staff are often employed temporary staff. Many contracts have therefore been already interrupted. Therefore reaction times may slow down and the preparation of terminals for reopening cannot start even due to investments at air terminals which have been completely frozen even if due to maintenance aspects,
- airports as well as Airlines financial fast decline can lead companies to bankruptcy.

To face these problems and support air terminal managers and airport authorities TXP currently puts very much effort into practical issue management for understanding the problems of European hubs and implementing the IATA guideline into operational practice within the special and structural systems of (European) air terminals<sup>30</sup>. Aircrafts allow a transport volume of around 50% respecting the distancing rules. Italian air terminal managers suppose to reach 25% of usual traffic load by March 2021. Thus our first focus lies with reaching the maximum throughput at the currently open terminals and the first terminals to be opened at secondary hubs. Bundling the catalogue of measures, devices and formation efforts will lead to a step-by-step implementation plan for single terminals trying to filter the lessons to learn for generalization e.g. for bottleneck handling in narrow paths, commercial issues or sanitary service handling. At first we are focussing on practical aspects which are certain to be binding at reopening e.g. on the spatial feasibility of distancing in air terminal ground plans or location options for temperature monitoring.

At the same time we are in touch and ready to support national and international consortia and authorities trying to push the development of practicable guidelines as soon as the timeline becomes clearer. Even though the reopening may be postponed continuously (Forbes assumes for Europe until the End of September<sup>31</sup>) in Europe, other countries already start now.

Even though at TXP we research on air terminals from a structural, managerial, environmental and passengers point of view for many since the beginning of the century, we are very well aware, that improvements have not been as strong in this field as it has been in aircraft and airside handling processes. This is due to several aspects, the main of which is, that the air terminal is not seen as more than a node in the transportation system by legislation and funding schemes, thus research bodies usually concentrate at most on tangential matters regarding the function of the terminal as black box leading passengers to airplanes or systematically for the isolated monitoring and safety issues. But the

COVID-19 pandemic shows emblematically that the lack of scientific knowledge of the aspects interacting within the terminal design may lead to solid effects on transportation as well as public health. TXP looks very much forward to changing this view and to define scientific and applicative working groups to better understand and integrate air terminal functions especially in view of terminals growing into satellite resilient cities as foreseen by many studies, where shut-downs and openings have to be conceived as natural and manageable side-effects, not destructive events threatening with the breakdown of the whole system.

## Post Scriptum

While studying these pages the reader probably noticed changes in some of the aspects described. Due to the subject's nature we would like to underline, that the article can only be interpreted as a working document trying to summarize the few certainties and point out the many uncertainties representing the background of air terminal management at the end of April 2020 in the middle of the COVID-19 pandemic. We would be extremely pleased, if it could lead to working groups at European, international and interdisciplinary levels and to best prepare aviation and governmental actors to define a more certain environment for the important economic and societal factor represented by aviation. To prepare a scientific support to future discussions of what EU Ministers of Transports and the Commissioner Vălean acknowledged: "The Multiannual Financial Framework and the Recovery Fund should fully reflect the needs of the EU transport sector especially in terms of liquidity and investments needed for the recovery of all the different stakeholders in the sector".<sup>32</sup>

## Notes

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