Report on the Development of Paperless Air Travel in China

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I. Introduction

To continuously enhance transport services and promote the application of intelligence, information and digital technologies in civil aviation industry of China, act upon the principle of Whole-hearted Service, and expedite the building of a distinctive service brand for China's air transport, on December 27, 2017, Feng Zhenglin, Administrator of the Civil Aviation Administration (CAAC), proposed at the 2017 National Civil Aviation Work Conference to promote paperless travel in the civil aviation sector. Over 3 years, CAAC has issued and refined relevant policies and standards one after another to promote and universalize paperless travel at domestic airports.

1. Background

The paperless travel involves many aspects passengers' journey, including ticket booking, check-in, security check and boarding, which involved various electronic and paperless applications, such as e-ticket[1], e-boarding pass[2], e-temporary identification certificate for flight taking, as well as a variety of online services and paperless products introduced at some airports, for example, smart checking baggage, smart parking and smart flight information display facilities. The paperless travel project (also known as the self-service check-in project) launched by CAAC in 2018 mainly aimed to promote the implementation of paperless travel in the industry with e-boarding pass as its core.

1 E-ticket: a reservation for an airline flight for which the details are recorded electronically without issuing paper ticket.

2 E-Boarding Pass (EBP) is a paperless boarding pass which records passenger-related information electronically, such as name, flight number, boarding gate and seat number. At present, EBP with QR code, as its main form, is stored in smart phone which allows passengers to go through check-in, security screening and boarding.

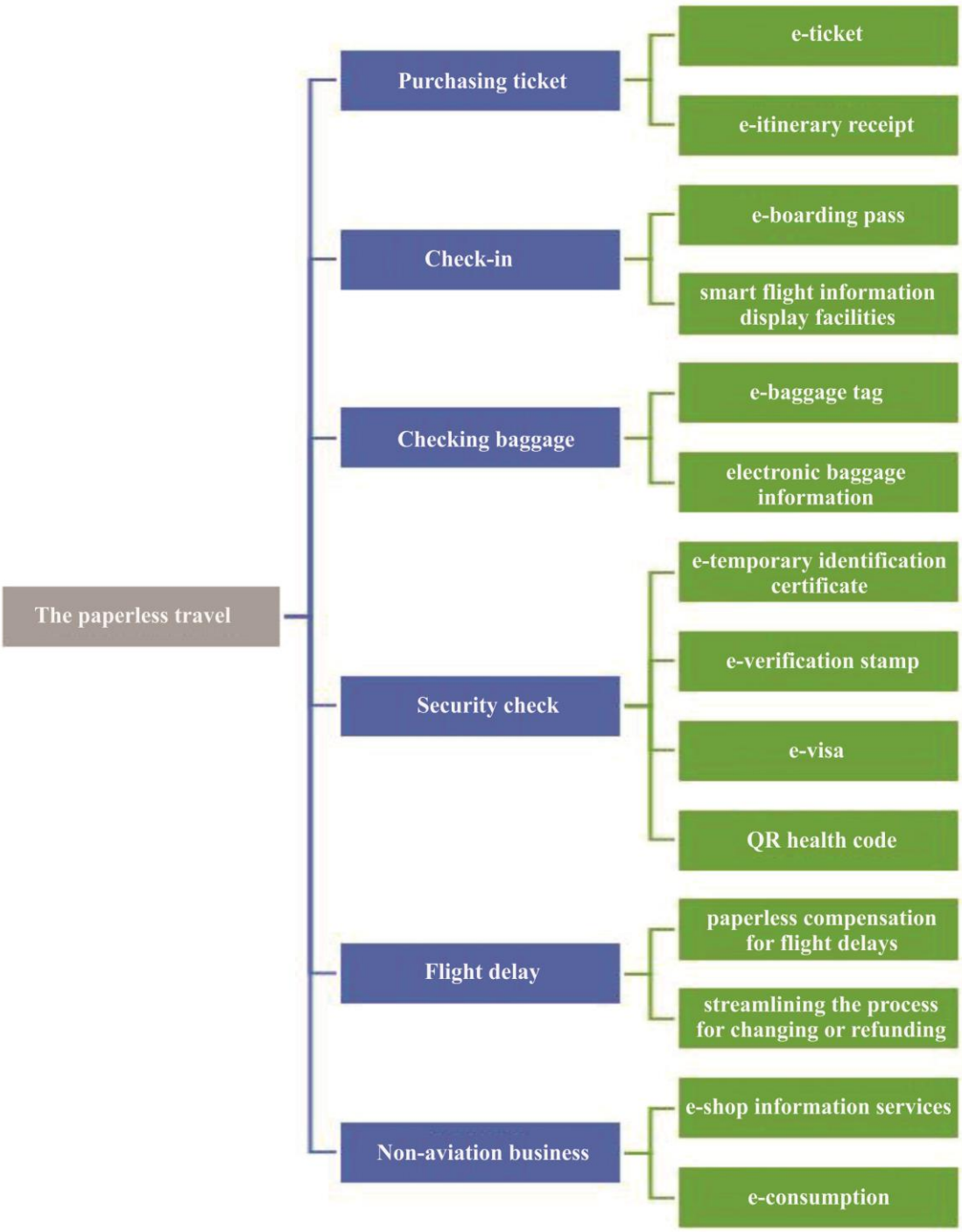

Figure 1-1 Implementation of Paperless Travel in the Industry

As early as 2004, the implementation of paperless travel had been introduced in the industry by popularizing e-ticket, which changed air travel mode and improved air transport services. For the first time, passengers enjoyed travel convenience and good services brought forth by paperless travel. E-ticket is an electronic form of air ticket or ticket stub and can be purchased via the website and APP. With e-ticket, passengers do not need to print paper ticket in advance and use it to go through check-in. In addition,

it is not necessary for passengers to have paper ticket if they want to change their flights or encounter flight delays, saving time for passengers and airlines and simplifying air travel process.

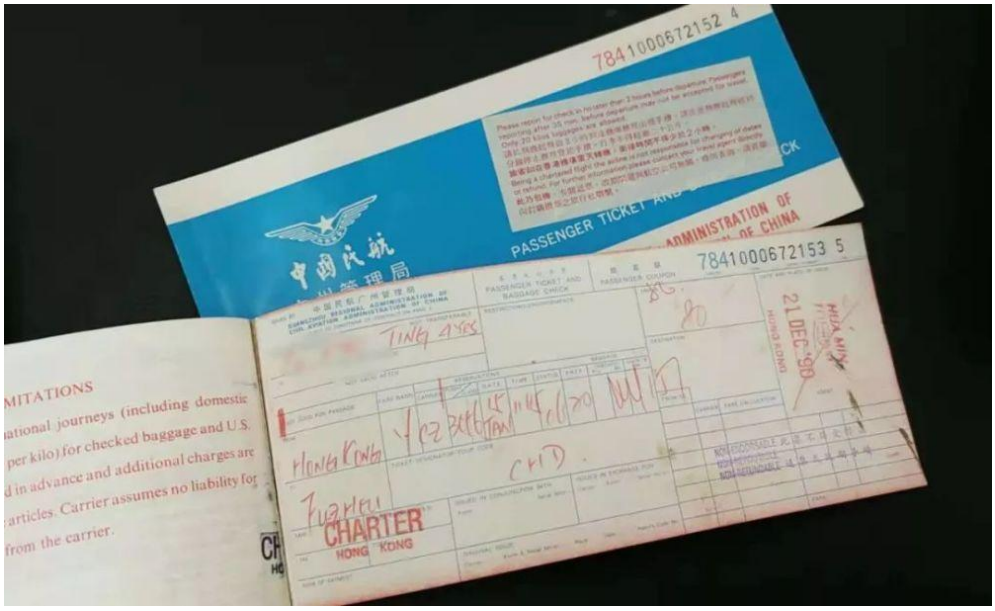

Figure 1-2 Paper Ticket used in the Past

With the implementation of a strategy for popularizing air travel, passengers will have more requirements of air travel services and wish to enjoy greater autonomy for boarding process and their journey. Driven by demands and technology, China introduced paperless travel at airports with an annual passenger traffic of over 10 million in 2018, achieving the goal of over 70% of passengers using self-service check-in at these airports by the end of 2019. The onset of COVID-19 in 2020 forced people to keep social distance, which further promoted the implementation of paperless travel in the industry, and made more passengers take paperless travel modes such as self-service check-in as their first choice. It is expected that there will be a revolution for facilitation of air travel, with the promotion and development of paperless travel. **For passengers**, the paperless flight process not only shortened their waiting time and effectively saved time, but also safeguarded passengers' personal information. In addition, it improved their willingness and satisfaction of travelling by air. **For airports**, it reduced the employment of airport facilities and equipment as well as front-line staff at the airport, optimized travel process, improved travel efficiency, as well as provided with passengers more opportunities to experience non-aviation products that raised airport revenue. **For airlines**, it improved passenger-related information exchanges, reduced the deployment of relevant facilities and human resources, enhanced passengers' travel experience, increased passenger loyalty, promoting service quality and brand building. **For the sector**, first, it reduced operating costs and realized the green and sustainable development; second, it effectively reduced infection risk between passengers and the airport personnel and air

goods amid the COVID-19 and enhanced regular epidemic prevention and control, thus creating a safe travel environment for passengers; third, it promoted the civil aviation safety management and increased passengers' satisfaction with air travel by a large margin, enhanced the overall image of China's civil aviation, further achieved aviation market potential and expanded domestic demand, which expedited the building of the new development paradigm featuring dual circulation, in which domestic and overseas market reinforce each other, with the domestic market as the mainstay.

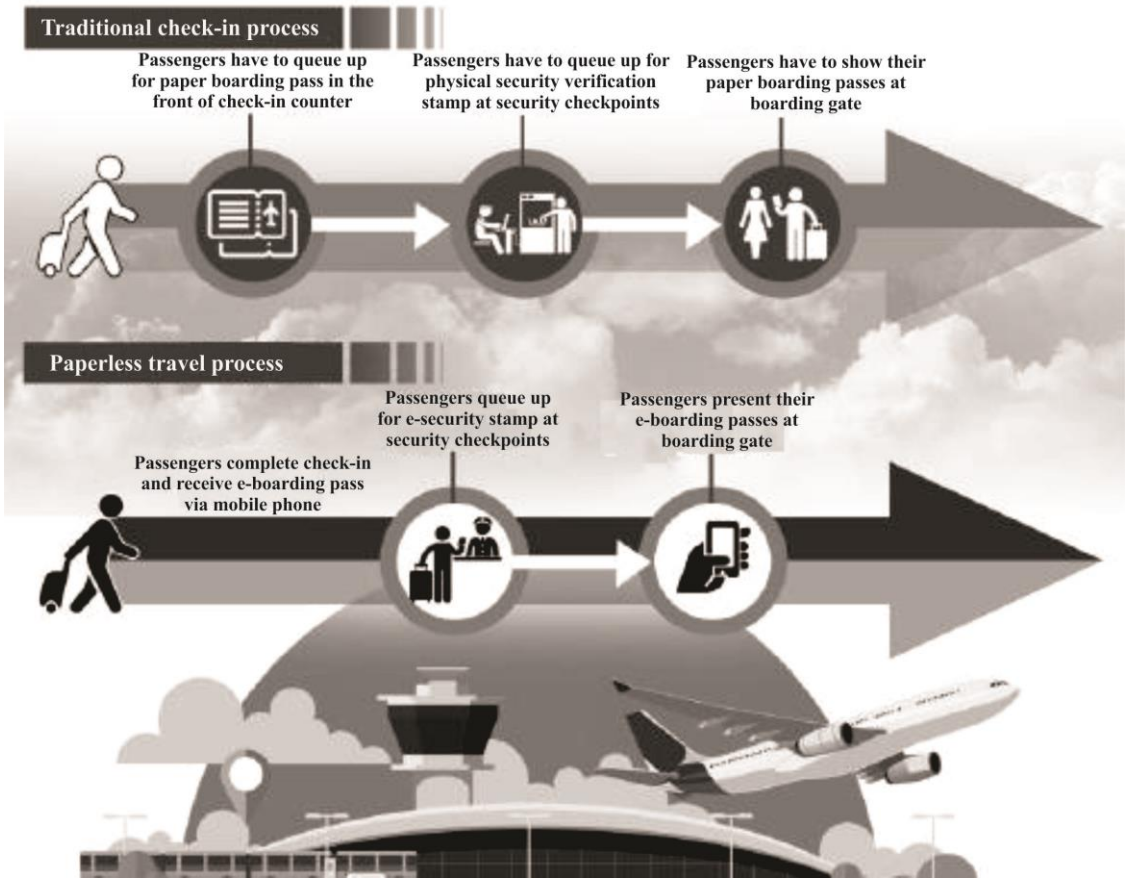

Figure 1-3 Comparison between Traditional Check-in Process and Paperless Travel

In general, the popularization of paperless travel will serve as not only a vital catalyst for the social and economic development, but also a new means of integrating sci-tech innovation with people's lives, which to a certain extent will improve passengers' travel quality as well as reflect a sense of responsibility and the eagerness to take on challenges by China's civil aviation community in building a civil aviation powerhouse and achieving high-quality development of the sector in the new era. In the future, the paperless travel, as a new technological revolution, will deeply change people's way of life, bringing profound effects on the rapid and sustainable development of the industry.

2. Significance of Development

Essentially, paperless travel is an important means of improving public services provided by the industry, and also a systematic project that involves such aspects as technology application, laws improvement, society application and system innovation, which needs to solve a series of problems, including passengers' travel habits, airport business process, the airlines' marketing, operation and maintenance, as well as the breakthrough in industry traditions. Therefore, the promotion of paperless travel cannot be accomplished in one move and it is indeed a gradual improving process.

First, the implementation of paperless travel is based on technological development. In recent years, with the rapid development of science and technology, in particular, technical barriers in electronic signature authentication and electronic information exchange have been removed, which eliminated difficulties in maintaining electronic signature's originality, integrity and non-repudiation for a long time, laying a technical foundation for industry-wide popularization of paperless travel.

Second, the implementation of paperless travel is guaranteed by improvements in the legal system. The Article 31 of the new edition of *Rules on Civil Aviation Security Screening* (Order No. 76 of the Ministry of Transport, 2016), which came into force on January 1, 2017, provides that the civil aviation security inspection authorities shall verify whether the passengers, their valid ID and valid tickets are consistent or not, and it they are, the inspector shall stamp on their paper tickets. In paperless travel process, security check status is recorded and verified in a systematic and electronic way, and by using digital boarding pass the physical verification stamps on paper ticket also replaced by the electronic ones, which provides with passengers a legal guarantee in using e-boarding pass with QR codes to enjoy a rapid, effective and convenient travel by air.

Third, the implementation of paperless travel is designed to be applied in society. On the one hand, passengers used self-service check-in equipment during check-in and security check to simplify ID verification process from previous mode of “ID card + boarding pass” to current one “ID card + QR code”, which reduced the use of airport resources, optimized travel process, improved the efficiency of check-in and security check, significantly reduced the workload of front-line staff, and saved time cost of passengers' travel. On the other hand, the self-service check-in reduced paper cost of boarding pass, realized the green and efficient travel, avoided passengers' embarrassment of looking for their boarding passes, and built a firewall for passengers' personal information.

Lastly, the implementation of paperless travel is the progress of institutional innovation. In recent years, the industry has issued various guidance documents, including *Project Planning for Promoting Paperless Travel at Domestic Airports with an Annual Passenger Traffic over 10 Million*, *Notice on Promoting the Project for Paperless Travel*, and *Notice on Improving Service Quality of Paperless Travel* serving as the guidance for all stakeholders in the industry for their active application of new technologies and continuous explorations and practices in the investment in software

and hardware infrastructure, process facilitation as well as marketing and publicity. By strengthening coordination and cooperation among various relevant entities, paperless travel achieved a breakthrough, which expedited the transformation and upgrading of air travel services and improved high-quality development of the industry.

In conclusion, promotion of paperless travel in the industry represents an important, long-term and farsighted measure, which has significance for China's civil aviation in the following four aspects:

(1) It is a logic choice for China's civil aviation in new phase of industrial development. By now, China has embarked on a new journey for building a modern socialist country in a comprehensive way and pressing forward for the second centenary objective. China's civil aviation has ranked second globally in such transport indicators as total transport turnover, passenger traffic and cargo & mail turnover for years, as well as has successfully completed tasks set for the 13th Five-Year Plan period with remarkable achievements. In the meantime, China has basically achieved the transition from a country with big air transport market to a powerhouse with a strong air transport market. However, the people's needs for air travel have not been fully accommodated by the supply of air transport service, and there is still a big gap to fulfill their aspirations for a better life. For this end, the popularization of paperless travel is a logic choice made by the civil aviation industry, which helps shore up the weak links in air service, comprehensively enhance the passenger's travel experience, improve their travel willingness as well as unleash the industrial potential.

(2) It is a specific measure for China's civil aviation to put into practice the new development concept. The core of new development concept is technological innovation and business mode change, and paperless travel represents a true reflection of this concept. Before the COVID-19 outbreak, paperless travel saved passengers' check-in time through technological innovation and process optimization, promoted passengers' control of air travel, enhanced their satisfaction, and further improved their travel experiences. In addition, for airlines and airports, the investment in facilities and equipment and the use of paper also were reduced by implementing paperless travel. Since COVID-19, paperless travel reduced unnecessary contact among passengers, airports and airlines, which ensured normal operation of flights under the precondition of COVID-19 prevention and control, resulting in increases in passenger load factor and economic benefits for airlines. Furthermore, paperless travel allowed passengers to have more time to enjoy catering, shopping, advertising and VIP lounges at the airport, which was conducive to raising airport non-aviation revenue, thus reaching a win-win situation for passengers, airports, airlines and even the whole industry. Going through the test of COVID-19, the civil aviation industry will uphold the concept of high-quality development featuring innovation as first driver, coordination as inherent characteristics and sharing as the ultimate goal to expedite the implementation of paperless travel.

(3) It is an innovative practice for China's civil aviation to serve for the new development pattern. For years, the industry has provided passengers with traditional

air travel services, which required them to use One card + One pass (ID card and boarding pass) to receive security check. Also, there have been some deficiencies in transfer service, such as defects of product design, inefficiency of flight connection and poor travel experience, resulting in passengers' fear of air travel and greatly limiting their willingness to travel by air. Given these circumstances, it is necessary for the whole industry to combine the strategy of expanding domestic demand with the supply-side structural reform to promote paperless travel, so as to create new demands that driven by innovation and led by high-quality supply as well as to foster a complete system for domestic demand, which is a vivid example of focusing on domestic market, boosting domestic consumption and serving new development pattern for the China's civil aviation industry.

(4) It is a signature task for China's civil aviation to achieve high-quality development. Globally, so far there is no country that has fully implemented paperless travel across its civil aviation industry. The standard system and the implementation plan for paperless travel established by China's civil aviation, including technical systems, facilities and equipment, as well as services and products, based on efforts of the industry and the best practices of some airports and airlines, will be an international example for and play a leading role for the development of civil aviation around the world. In addition, paperless travel will be conducive to continuously improving core competitiveness of the civil aviation industry, and striving to promote the establishing of China's civil aviation service brand, featuring Whole-hearted Service as its core and meeting the needs of passengers, so as to boost the building of a civil aviation powerhouse and high-quality development of civil aviation in the new era.

II. Promotion of Paperless Travel

1. Course of Development

Internationally, in recent years, the International Air Transport Association (IATA), focusing on passenger demand, technological revolution, and industry innovation, has introduced several programs in a bid to promote steady improvement of the self-service and paperless air services for passengers travelling by air around the world, wishing to significantly increase their satisfaction for air travel. The E-ticketing program and the e-document procedure respectively launched in 2008 and 2012, with their 100% popularization globally, created new modes of sales platforms such as OTA and OTM, opened a new chapter for civil aviation e-commerce. In addition, the Fast Travel program for facilitating passengers’ journey has significantly improved the self-services at large airports worldwide, including check-in, baggage checking, travel document verification, flight change and loss baggage report. In 2017, IATA and the Airports Council International (ACI) jointly established the New Experience in Travel Technology (NEXTT) initiative to promote a new round of technological innovation in the entire industry, of which the Off-airport Activities program are closely connected with the paperless air travel. When the initiative was launched, the civil aviation departments in various countries, using off-airport check-in as a starting point, carried

out self-service and mobile phone check-in to enable passengers to complete check-in before arriving at the airport. By now, the paperless air travel has made it possible for passengers all over the world to enjoy more convenient air travel services while enhancing operating efficiency significantly and effectively reducing operating cost of the airports and airlines to speed up their intelligent transformation. According to preliminary statistics, the paperless air travel services have reduced the cost of the entire industry by approximately US$2.1 billion every year.

With the rise of people's living standards and the implementation of a strategy for popularizing air travel, China's air transport market has reported sustained and rapid development, with more people choosing to travel by air. So far, the number of air passengers in China has reached nearly 700 million, which formed a solid foundation for market and brought more demand for aviation services. On the one hand, passengers hoped to have greater autonomy of their journey, which stimulated potentials for self-service process, while the airlines were eager to provide passengers more convenient travel services. On the other hand, in recent years, software and hardware infrastructure for security check, border control and customs at airports across the country have been significantly improved, laying a foundation for technology application of paperless travel. In addition, domestic airports with an annual passenger traffic over 10 million have reached capacity limits and faced increasingly operational pressure, resulting in an urgent need for electronic services and paperless travel to meet the fast-growing market demands.

To carry out simplified travel process services, such as the New Travel Experience Technologies (NEXTT) initiative and One ID plan, to actively address challenges of improving the industry's service quality and operation efficiency, as well as to meet the needs for improvement in passengers' travel experience, China's civil aviation, by insisting on putting people first, upholding the concept of Whole-hearted Service and implementing reform and innovation, has made a great deal of helpful trials to streamline air travel process, including Off-airport Self-service Check-in, which served as the breakthrough for paperless travel and made passengers easily complete check-in process, thus steadily enhancing people's sense of gain, happiness and security and changing traditional aviation service mode and concept.

In December 2017, Feng Zhenglin, Administrator of CAAC, proposed a priority work at the 2017 National Civil Aviation Work Conference, namely "to implement paperless travel at airports with an annual passenger traffic over 10 million to make passengers complete all flight processes via only valid ID card, mobile phone and other mobile devices".

On March 30, 2018, CAAC issued guidance documents, including *Program for Promoting Paperless Travel at Domestic Airports with an Annual Passenger Traffic over 10 Million*, which laid down comprehensive arrangements for the implementation of paperless travel at the above airports and set the goal to promote convenient travel for passengers at domestic airports with an annual passenger traffic over 10 million (based on 2017 passenger throughput) to allow passengers to complete all check-in

procedures by only using valid ID card and mobile phones, thus ultimately achieving the goal of fully implementation of whole-process paperless travel. CAAC also established a leading group to promote paperless travel, with Wang Zhiqing, then Deputy Administrator as the chief of leading group, and Liu Feng, then Director General of Department of Transport as its assistant chief. There was an office under Division of Domestic Transport of the Department, with Yu Biao, then Deputy Director General of the Department as the head of the office.

On May 31, 2018, CAAC Department of Transport and Bureau of Aviation Security co-organized an on-site survey and held a meeting in Zhengzhou, with about 40 persons from relevant regional administrations, Bureau of Aviation Security, some Safety Supervision and Management Bureaus (SSMBs) and their aviation security divisions, China Air Transport Association, IATA, TravelSky and relevant airports as participants.

On September 10, 2018, CAAC issued *Notice on Promoting the Project for Paperless Travel*, with *Introduction to Paperless Customs Clearance* as its appendix, which specified requirements of "raising awareness to strengthen responsibility; understanding the requirements to define goals and accelerating promotion to achieve practical results".

On October 29, 2018, paperless travel services for international flights and the flights between China's mainland and Hong Kong, Macao and Taiwan at Shanghai Pudong International Airport (Shanghai Pudong Airport) were officially launched. Passengers who planned to take flights operated by Cathay Pacific Airways at Shanghai Pudong Airport could completed full flight process such as immigration inspection, security check and boarding via e-boarding pass with their mobile phones without any paper ones to be obtained from manual check-in counters or self-service check-in equipment. Shanghai Pudong Airport became the first airport in China that provided paperless travel services for the flights between China's mainland and Hong Kong, Macao and Taiwan.

On December 25, 2018, CAAC issued *Notice on Selecting Exemplary Entities to Implement Paperless Travel* in the industry. CAAC leading group for paperless travel, according to the recommendation of regional administrations, selected 15 airports and 6 airlines as exemplary entities, including Beijing Capital International Airport, Guangzhou Baiyun International Airport, Air China Co., Ltd., and China Eastern Airlines Co., Ltd. All above airports and airlines have rapidly implemented and comprehensively promoted paperless travel, developed reasonable boarding process for passengers, made the best of advertisements and reported higher proportion of departing passengers who experienced paperless travel.

At the end of 2018, a total of 227 airports and 35 airlines across the country had implemented paperless travel with 225 million passengers using self-service check-in, which saved 45 million yuan on printing paper boarding passes, reduced carbon emission by 3375 tons and reduced 230 million hours for passengers, realizing remarkable economic and social benefits.

On April 2, 2019, CAAC issued *Notice on Upgrading Paperless Travel in the Civil Aviation Industry* and encouraged some international hub airports in such cities as Beijing, Shanghai, Guangzhou, Chengdu, Kunming, Shenzhen, Chongqing, Xi'an, Urumqi and Harbin, drawing upon the experiences in paperless travel for international/regional flights at Shanghai Pudong Airport as references and a benchmark, to strive for introducing paperless travel services for international flights and the flights between China's mainland and Hong Kong, Macao and Taiwan by the end of 2019.

With the continuous promotion of paperless travel, the entire industry will continue to reform and innovate, optimize and simplify process, and improve efficiency, so as to make passengers' travel more convenient and to better meet their needs for a better journey. Through unremitting efforts of all parties, by now, paperless travel has been well implemented in ticket, boarding pass and temporary identification certificate. By the end of 2019, 229 airports (96.2%) and major airlines had implemented paperless travel. In addition, the average percentage of domestic passengers who went through self-service check-in at all airports with an annual passenger traffic over 10 million had reached 70.5%, successfully completing the goal set at the beginning of the year and better meeting people's needs for high-quality air travel. The next step for CAAC is to further optimize and align the procedures for and standards of paperless travel, against the standard requirements of building a civil aviation powerhouse and based on expanding paperless travel. With the development of science and technology, paperless travel will be extensively applied in various travel processes in the industry in the future, making passengers' travel more convenient and comfortable.

2. Promotion of Paperless Travel

As previously mentioned, paperless travel was also known as the paperless flight taking process that needs to be implemented step by step. At present, it mainly focuses on paperless boarding pass, namely e-boarding pass. Passengers use e-boarding pass with QR code that obtain from check-in platforms of airlines, airports or the authorized third-parties, and their valid ID cards to complete such check-in procedures as security check and boarding to experience paperless travel.

(1) Definitions

The paperless travel is divided into self-service check-in process and whole-process paperless travel.

A. Self-service check-in process

Passengers conduct check-in for the first time when they travel by air in following ways:

1) At-airport self-service check-in: passengers complete travel document verification and seat reservation themselves by using self-service check-in equipment at the airport.

2) Off-airport self-service check-in: passengers complete travel document verification

and seat reservation themselves by using airlines' official websites, APPs, Mini Programs, the third-party platforms and text messages.

- Check-in via official websites: passengers log in self-service check-in interface via airlines' official websites to complete ID verification and seat reservation themselves.
- Check-in via APPs: passengers log in self-service check-in page via airlines' APPs to complete ID verification and seat reservation themselves.
- Check-in via Mini Programs: passengers log in self-service check-in interface via WeChat APP to complete ID verification and seat reservation themselves.
- Check-in via the third-party platforms: passengers complete ID verification and seat reservation themselves via the third-party platforms, for example, Umetrip APP.
- Check-in via SMS: passengers conduct check-in by sending and receiving text messages.

B. Whole-process paperless travel

Passengers will not need to print and use paper boarding pass throughout the travel from check-in and security check to boarding, which is the ultimate goal of paperless travel.

The paperless travel not only improves passengers' air travel experience to allow them control journey freely, but also integrates check-in methods and channels of various airlines, reduced operating cost and improved efficiency. As more passengers choose off-airport check-in, airlines will phase out manual check-in counters and optimize the use of airport resources, so as to effectively alleviate airport operation pressure, enhance airport capacity support, effectively increase commercial resources, as well as raise ancillary revenue.

As the competent authority, CAAC, taking paperless travel as an important measure for and a vital way of implementing the people-centered notion, has established relevant regulations and standards and played a better role in leading stakeholders in the industry. Under the guidance of CAAC, Travelsky, in cooperation with other players in the industry, has applied new technology to explore in such relevant fields as investment in software and hardware infrastructure, simplification, improvement and promotion of paperless travel, so as to make domestic passengers conduct check-in only with valid ID cards and mobile phones and to smoothly implement paperless travel across the country, resulting in its popularization and a leading position in the world.

(2) Implementation of Paperless Travel

From 2017 to 2019, CAAC, based on domestic air transport market and focused on airports with an annual passenger traffic above 10 million, promoted paperless travel in the industry. By the end of 2020, there had been 241 airports across the country, among

which 233 airports (96.6%) had provided paperless travel services for domestic flights (and major airlines had the same services), and 112 ones had introduced paperless customs clearance for international and regional flights.

Figure 2-1 Self-service Check-in Equipment at a Domestic Airport

In light of the fact that 2020 data was affected by COVID-19, this report used 2019 data as reference for popularizing paperless travel at each airport. In 2019, the average percentage of self-service check-in for domestic passengers at all airports with an annual passenger throughput above 10 million across the country reached 70.5%, with that of whole-process paperless travel 51.5%. More than 1.4 million passengers at airports with an annual passenger traffic over 10 million in China experienced self-service check-in for international and regional flights, realizing the set goal of "promoting paperless travel from domestic flights to international and regional flights and increase the percentage of passengers who used self-service check-in at the above airports to over 70%."

(3) Popularization of Paperless Travel at Airports

The percentage of paperless travel at airports with an annual passenger throughput over 10 million was estimated based on 2019 operation data of domestic airports. In the actual calculation, the number of departing domestic passengers (passengers who took the flights between China's mainland and Hong Kong, Macao and Taiwan not included) served as a benchmark to estimate the percentage of **self-service check-in travel** and **whole-process paperless travel**. The data are shown in Table 2-1 below:

Table 2-1 Paperless Travel Services Used by Passengers at Airports with an Annual Passenger Throughput over 10 Million across the Country in 2019

NO.	Airport	Number of domestic passengers (passengers who took the flights to/from Hong Kong, Macao and Taiwan not included) [1]	Self-service check-in		Whole-process paperless travel	
			Number of passengers [2]	Percentage	Number of passengers[2]	Percentage
1	Beijing Capital	36194098	29803793	82.3%	23729994	65.6%
2	Guangzhou Baiyun	27115763	20853572	76.9%	16952638	62.5%
3	Chengdu Shuangliu	24365501	19431622	79.8%	13581535	55.7%
4	Shenzhen Baoan	23232535	17158161	73.9%	15303907	65.9%
5	Kunming Changshui	21799157	14915800	68.4%	10566736	48.5%
6	Xi'an Xianyang	21613761	15330598	70.9%	11898132	55.0%
7	Chongqing Jiangbei	20765778	15013346	72.3%	10353213	49.9%
8	Shanghai Hongqiao	21056055	17715561	84.1%	13698480	65.1%
9	Shanghai Pudong	18618779	12685249	68.1%	10002592	53.7%
10	Hangzhou Xiaoshan	16944928	12677563	74.8%	8147594	48.1%
11	Zhengzhou Xinzheng	12951721	10110009	78.1%	6032953	46.6%
12	Nanjing Lukou	13013268	8301045	63.8%	6557545	50.4%
13	Urumqi Diwopu	11337550	6738250	59.4%	6062038	53.5%
14	Wuhan Tianhe	11364656	9568105	84.2%	6370217	56.1%
15	Changsha Huanghua	11489337	9117709	79.4%	5846219	50.9%
16	Xiamen Gaoqi	11753560	7951081	67.6%	5250059	44.7%
17	Haikou Meilan	11360247	5325645	46.9%	4753974	41.8%
18	Qingdao Liuting	10270121	6997155	68.1%	4854238	47.3%
19	Tianjin Binhai	9932051	6567617	66.1%	4850610	48.8%
20	Guiyang Longdongbao	10557762	6218262	58.9%	3882814	36.8%
21	Harbin Taiping	9946031	7562325	76.0%	5058511	50.9%
22	Sanya Fenghuang	9447902	5010512	53.0%	4205433	44.5%
23	Dalian Zhoushuizi	8801791	6223757	70.7%	4481564	50.9%
24	Shenyang Taoxian	9337054	5837795	62.5%	4246568	45.5%
25	Ji'nan Yaoqiang	7561407	3924610	51.9%	3064744	40.5%
26	Nanning Wuxu	6993029	4782038	68.4%	3333018	47.7%
27	Changchui Longjia	6645848	4271427	64.3%	3412061	51.3%
28	Lanzhou Zhongchuan	7013203	4430202	63.2%	2708563	38.6%
29	Taiyuan Wusu	6333483	4379059	69.1%	2824167	44.6%
30	Zhuhai Sanzao	6038345	3959920	65.6%	2452787	40.6%
31	Hohhot Baita	6214270	4234354	68.1%	2821181	45.4%
32	Fuzhou Changle	6169544	4497706	72.9%	2812798	45.6%
33	Nanchang Changbei	5803349	3643397	62.8%	2281472	39.3%
34	Wenzhou Longwan	5686846	4016791	70.6%	1895946	33.3%

35	Hefei Luogang	5288349	3297653	62.4%	2209332	41.8%
36	Ningbo Lishe	5259102	3487993	66.3%	2061836	39.2%
37	Shijiazhuang Zhengding	5395166	2734770	50.7%	1561737	28.9%
38	Yinchuan Hedong	4881784	2292021	47.0%	1960098	40.2%
39	Yantai Penglai	4098192	2306457	56.3%	1461973	35.7%
Total		**472651323**	**333372929**	**70.5%**	**243549276**	**51.5%**

Notes:

1. The number of domestic passengers at each airport (passengers who take the flights between China's mainland and Hong Kong, Macao and Taiwan not included) is quoted from Statistical Bulletin of Civil Aviation Industry, which is the difference between the number of departing passengers and that of transfer ones.
2. The number of passengers who use self-service check-in and experience whole-process paperless travel is summarized according to the data from TravelSky, China Southern Airlines Co., Ltd., Spring Airlines Co., Ltd. and 9 Air Co., Ltd.

(4) Promotion of Paperless Travel on Air Routes

At the 2018 National Civil Aviation Work Conference, CAAC, by focusing on service quality to improve passengers' satisfaction, officially made the promotion of paperless travel as a priority of key projects for improving service quality in the entire industry, and encouraged airlines and airports to introduce paperless travel services on domestic air routes.

As of 2019, the percentage of passengers who enjoyed paperless travel services at airports with an annual passenger traffic over 10 million had reached over 70%. To consolidate the results achieved in 2018, in early 2019, the civil aviation community, adhering to the guiding principles of the 2018 Annual Civil Aviation Work Conference and relevant instructions of CAAC leaders, actively applied such technologies as facial recognition, self-service check-in, self-service baggage checking and intelligent inquiry to promote paperless travel from domestic flights to international and regional ones.

In the second half of 2019, some airlines, in cooperation with airports, launched paperless travel services on regional and international air routes and made remarkable progress. Self-service customs clearance had been implemented on several international and regional air routes, including Kunming-Sydney flight operated by China Eastern, Wuhan-Hong Kong and Guangzhou-Singapore flights by China Southern, as well as Beijing-Bangkok and Shenzhen-Brisbane flights by Hainan Airlines.

Figure 2-2 Changsha Huanghua International Airport Provided Paperless Travel Services for Intercontinental Flights

Changsha Huanghua International Airport (Changsha Airport), working with Hainan Airlines, actively implemented paperless travel process for international flights. On January 4, 2019, Changsha Airport implemented paperless travel process for international flights. Twenty passengers who took flight HU7997 (Changsha-Sydney) used whole-process paperless travel via WeChat account of Hainan Airlines and Umetrip APP and were satisfied with the process, marking a good start of "zero accident, zero repatriation, zero complaint and all high praise". The airport, in cooperation with Hainan Airlines and TravelSky, carried out full-process paperless mode in customs clearance, customs re-verification, border IAPI verification, security check, boarding, and second re-verification at cabin doorway for international flights, which indicated passengers would conduct IAPI verification, check-in and seat reservation via airlines' APP, WeChat or Umetip APP before arriving at the airport in the future.

Kuming Changshui International Airport (Kunming Airport), working with China Eastern, actively implemented paperless travel process for international flights. On June 4, 2019, passengers who took flight MU2583 (Kunming-Bangkok) operated by China Eastern used a pilot test for paperless customs clearance via the airlines' APP and Umetrip, marking a big success. In that pilot project, according to the requirements of border control units at the airport and the verification provisions of the countries where passengers would entry into, the electronic verification stamps were synchronously displayed on e-boarding pass. In the future, international passengers departing from Kunming Airport will be able to complete ID verification required by the countries where they will enter and complete seat reservation via mobile phones before arriving at the airport, which will effectively shorten 1-1.5 hours comparing with using traditional check-in process.

Chengdu Shuangliu International Airport (Chengdu Airport), working with Sichuan Airlines, actively carried out paperless travel process for international fights. On June 6, 2019, passengers who took flight 3U601 (Chengdu-Melbourne) operated by Sichuan Airlines used complete paperless customs clearance via Umetrip APP (officially authorized by Sichuan Airlines), which was a successful test based on Flight Information APP (Hangxintong) for international passengers.

3. Special Passengers Services

In 2020, by implementing the people-centered notion, CAAC intensified its care for special passengers and combined traditional services with intelligent application and innovation to persistently improve measures and mechanism for services, optimize service process, refine service manual for special passengers, strengthen customer notification and focus on public opinions, so as to further optimize accessibility environment and improve service facilities and equipment for special passengers to improve such services in an all-round way, making such passengers as those with disabilities, the elderly and pregnant women enjoy paperless travel services.

Figure 2-3 The Elderly Experienced Air Travel at Domestic Airports

The implementation of paperless travel shall not exclude special passengers such as the elderly, instead, it shall better meet needs of passengers with different ages, occupations and travel conditions by obtaining passenger information in advance, so as to make a better service plan and to improve special service support, information communication, customer notification, and handling of special circumstances.

III. Implementation of Paperless Travel Services

The paperless travel, through upgrading facilities, applying technologies and building information platforms, optimized the traditional travel process at the airports and changed it from 3 steps, including check-in (at manual counters or by self-service equipment), security check and boarding into 2 steps, namely, security check and boarding. **On one hand**, it effectively solved some key issues, such as a long queue, slow customs clearance and electronic process unavailable during the travel, to improve passengers' travel experience. **On the other hand**, it effectively reduced the airlines' investment in such hardware and software infrastructure as manual check-in counter and self-service check-in equipment at the airports to provide with passengers

fast and convenient travel services, and speed up providing more diversified, personalized and differentiated value-added services, so as to help the industry achieve high-quality development.

1. Trend of Development

Over the past 3 years, the civil aviation community has made concerted efforts to improve paperless travel by continuously applying new technologies, new modes and new means, so as to provide with passengers a whole-hearted, comfortable and satisfactory travel experience. At present, some changes are taking place in four aspects in passengers' travel including check-in, ID verification, baggage and commerce.

(1) Off-airport Check-in

Off-airport check-in came true by implementing paperless travel, which not only improved passengers' air travel experience and allow them to have more control of their journey, but also integrated the ways that check-in is handled by various airlines, significantly reducing operating cost and improving operational efficiency. As more passengers choose off-airport check-in, airlines will phase out manual check-in counters to vacate airport physical space. By doing so, for one thing, it will effectively alleviate airport operation pressure and enhance airport capacity, and for another, it will improve other services provided by airports for passengers or increase airport ancillary revenue from resources released.

For example, **China Eastern**, working with **Beijing Daxing International Airport, made progress in check-in in 3 aspects**, including online check-in, no traditional way of check-in and e-boarding pass. Passengers will conduct online check-in via the airlines' official website or complete it 3 hours before taking off to save time used for check-in, and receive e-boarding pass by facial recognition and with general purpose ID documents.

With a continuation of requirements for COVID-19 containment, full off-airport check-in will be further promoted. A t the same time, it will reshape existing passenger service process at the airport, including redefining its business scope and functions, and bringing a new air travel mode and new changes in airport development in the future. For example, since 2019 some large domestic airlines have been exploring automatic check-in and seat reservation services that support automatic seat allocation for passengers who have not gone through check-in within hours before flight departure. In addition, some airlines have expanded seat reservation through online check-in, including seats nearby emergency exits, making the percentage of online seat reservation reach nearly 100%.

China Southern launched 100% seat pre-selection service that assisted passengers, who had not gone through check-in and selected seats, in automatically allocating appropriate seats, going through check-in and sending e-boarding passes 4 hours before taking off via the airlines' electronic service platform. When arrived at the airport, passengers directly went through security check and completed boarding with

e-boarding passes, which further simplified boarding process and provided passengers with paperless and convenient travel services.

Figure 3-1 Seat Pre-selection Service Launched by China Southern

All above positive and beneficial explorations and measures will gradually promote off-airport check-in, and further expand paperless travel.

(2) Intelligent ID Verification

At present, passengers who take domestic flight need to provide valid identity information and flight information, which are generally based on ID card and paper boarding pass. With the development and application of new technologies, the electronic transformation has emerged in the information of these two areas and their carriers. The prevailing mode is to combine various credentials paperless travel, namely ID document and QR code e-boarding pass. The popularization of paperless travel mode will replace traditional paper boarding pass. At the same time, single credential mode that only ID card serves as a carrier of identity and flight information for subsequent flight is being explored.

In the future, with progress of biometric technology, airport, airlines and relevant business entities will actively explore feasibility of biological identification technology application. Passenger's biological information will be collected in advance during off-airport check-in process to correlate their identity information, flight information and biological information, which be used by airlines and airports to implement One ID initiative, such as facial recognition, and will serve as a unique carrier for passengers' ID information verification during the whole travel. From ticket booking, security check, checking baggage to boarding, passengers will not need to show any identity documents and other documents, realizing the free of passengers' hands in real sense. In fact, the application of biometric verification technology in the whole travel process has fully upgraded passenger services through informatization and intelligence. In

addition, many domestic airports have introduced biometric verification in some flight processes.

For example, **Beijing Capital International Airport** (Capital Airport) applied large quantity of facial recognition technologies in e-customs clearance and information integration. First of all, based on paperless flight services realized in September 2019, Capital Airport, by integrating Hangxintong products with biometric technology, comprehensively introduced facial recognition at security check lanes and boarding gates at its three terminals, and implemented a self-boarding mode with facial verification by using self-service boarding equipment with facial recognition function at boarding gates, ensuring boarding efficiency and improving passengers' experiences. Then, self-service information collection channels for 24-hour international transfer passengers at Terminal 3 were launched, which integrated such technologies as API, facial recognition and outbound flight correlation to automatically complete passenger data input and collection, identity verification and flight statistics, reducing customs clearance time to 10 seconds, increasing transfer efficiency more than three times, solving the problem of long queues for transfer passengers effectively which make their travel more expeditious. In addition, based on such technologies as facial recognition, big data and voice recognition, the airport integrated passengers' travel information, service information and commercial information to develop an intelligent, personalized and comprehensive service terminal to provide passengers with flight information, boutique details, traffic information search, VR guide, Wi-Fi code taking, member registration and coupon collection. They seamlessly connected with APP and WeChat to integrate online and offline services enabling passengers to enjoy more convenient travel, control their journeys more freely, and experience personalized services.

In addition, **Daxing Airport** proposed the paperless travel concept which supports 100% passenger customs clearance with ID card and boarding by facial recognition without showing boarding passes in any form during the whole process. Upholding this concept, the airport introduced relevant product solutions allowing passengers to experience air travel innovation. First, 100% paperless process. The airport canceled traditional paper boarding pass and paper boarding voucher for remote aircraft stands, promoted a pilot project for RFID e-baggage tag and e-baggage claim coupon in cooperation with the airlines whose bases located at the airport, and phased out paper baggage tag and baggage claim coupon. Second, 100% boarding by facial recognition. Daxing Airport has a total of 124 self-service check-in kiosks and 101 pieces of facial recognition equipment at boarding gates, realizing 100% facial recognition boarding at 101 gates at near and remote aircraft stands. Third, self-service for domestic and international flight processes. The airport carried out a pilot project for international passenger travel process, a traditional difficulty in promoting paperless travel services, and received policy support from the joint inspection entities, by providing large number of self-service equipment for international passenger procedures, including border control and customs to simplify passengers' operations. Fourth, boarding pass was not used during the whole journey. At some domestic airports, boarding passes

were not presented in some travel process. Based on above measures, Daxing Airport integrated various links of travel process for domestic and international passengers to thoroughly correlate check-in, security check, boarding, departure tax rebates, tax-free shopping and backflow inspections, creating whole-chain and seamless paperless travel process.

China Eastern introduced new technologies, new modes and new applications in ID verification. First, it implemented self-service verification in security check to verify passengers with self-service facial recognition and ID information, providing self-service security inspection and customs clearance. Second, it introduced intelligent system in passengers' waiting process. With facial recognition, passengers entered VIP lounge and obtained flight information from smart flight information system. At same time, with the help of AR glasses, the airport staff could find out passengers quickly. Third, it provided passengers various methods for boarding. Passengers could board with ID card, e-boarding passes or by facial recognition, which changed traditional boarding mode. All above measures made passengers who took that airlines' flights enjoy a better travel experience and a more convenient and faster customs clearance.

In addition, **Shenzhen Airport** introduced the first mini program for tracking passenger flow based on facial recognition technology in China by which passengers did not need to use paper boarding passes during their travel. According to different needs of four groups, including departing passengers, transfer passengers, arrival passengers and visitors, the program promptly and accurately sent such information as arrival time of previous flight, layout and change of boarding gates, and boarding time to passengers, so as to allow passengers to know flight status timely and enjoy personalized services. At **Kunming Airport**, with the help of self-service verification channels, self-service boarding gates and PDA, passengers went through security check only with second-generation ID card and completed boarding process by facial recognition. At the same time, the security personnel who worked at remote aircraft stands did not verify passengers once again. **Yinchuan Airport** introduced facial recognition technology to actively explore whole-process smart services by equipment installed at check-in counters and security check lanes to assist passengers in accessing temporary identification certificates by facial recognition, which was convenient for passengers who did not carry ID cards and had expired ID cards. It is expected that new technologies such as whole-process biological recognition will be popularized in more areas in the industry.

(3) Personalized Baggage Services

With the progress of technology, conditions for off-airport checking baggage have been in place. On the one hand, baggage tracking had been one of key tasks for the industry since the publication of IATA Resolution 753 in 2018, which not only avoided huge losses caused by mishandling baggage every year, but also made passengers control their air travel freely and feel happy during the process. Moreover, in the future, with the increase of passengers, the number of checked baggage may even exceed that of passengers, which makes innovation and improvement for baggage handling process

urgent. In 2019, CAAC put baggage tracking as its one of work priorities and promulgated *Guidelines for Developing Air Baggage Tracking System* in a bid to encourage domestic airports to apply RFID and other technologies, as well as to strive to implement whole-process checked baggage tracking at airports with an annual passenger traffic over 10 million. Currently, large airports and major airlines are actively carrying out pilot projects for baggage tracking that are still in its initial stage to achieve more potentials. In the future, as baggage tracking technology matures and its cost reduces, more airlines and airports will implement whole-process baggage tracking and expand its scope by further deepening the development and sharing of data, technology and solutions across the industry. On the other hand, due to the improvements in baggage tracking technology and service, door-to-door baggage service chain will become more complete and provide passengers with more diversified and personalized products: they not only choose checking baggage at any place in the city, but also claim baggage throughout the itinerary at any time. All above procedures can be completed online. In addition to changes in front-end of services, baggage handling at the airport may also face more profound changes with such intelligent application as robots.

China Eastern, in cooperation with **Daxing Airport**, launched paperless checking of baggage and baggage delivery service. It introduced Passive E-baggage Tag APP, with which passengers correlated their identity information in advance and activated it at the airport to check their baggage, turning traditional baggage tags into paperless ones. Passengers will get baggage-related information and e-baggage claim stub via the airlines' official website. Baggage delivery service includes door-to-door baggage delivery, door-to-door baggage collection and baggage haulage. Passengers who fly to Daxing Airport can order online via its WeChat account and its official APP to choose door-to-door baggage delivery. When passengers arrive at the airport, they can make an appointment to remove their baggage to a designated place at the appointed time; if they depart from Daxing Airport, they can book door-to-door baggage collection service. The airport staff will recommend a close check-in location at the terminal to passengers to hand over the baggage. If it is not convenient for passengers who have too much baggage to carry, the business also provides baggage handling service, which assists passengers in carrying baggage as far as to security checkpoints. During COVID-19, cleaning and disinfection is strengthened during the service. When it is rainy and snowy, the ‘raincoat' is used to protect baggage.

Figure 3-2 Baggage Delivery Service Launched by Daxing Airport

Shenzhen Airport promoted innovations such as door-to-door baggage service and paperless baggage claim in the industry. Passengers will receive e-baggage claim stub via the airport's APP to verify and claim their baggage if they chose door-to-door baggage service.

Figure 3-3 Door-to-door Baggage Service Launched by Shenzhen Airport

So far, handling goods by robot has been recognized and applied widely in logistics field. If robot is used to deal with baggage at the airport, the traditional baggage handling mode and related processes will face more profound changes.

(4) Diversified Passenger Services

In recent years, with the development of the Internet and technical innovation, people

have generally developed a habit of consumption via smart devices such as mobile phone. As a result, more and more people chose online consumption and offline experience. Making use of the Internet, passengers can book, change and refund ticket, and even make a reservation for meals and carry out leisure activities at the airport. With the development of paperless mode, smart terminals, taking mobile phone as a typical example, will play a vital role in the future. Passengers will experience various services via smart devices, such as check-in, compensation for flight delay, shopping at the airport, real-time baggage tracking, smart navigation at the airport, in-flight WiFi, and door-to-door baggage delivery reservation. Besides consumption, passengers will also make comments or lodge complaints on services provided by airlines or airports via mobile phone to help other passengers to make consumption decisions.

Figure 3-4 Passengers are Searching for Restaurants and Stores at the Airport via Integrated Self-service Equipment

At **Yinchuan Airport**, passengers will get flight information by face recognition via smart flight information equipment that are seen everywhere at the airport after completing security check. If they have any questions, they can use smart service equipment at the terminal to find answers themselves or ask the airport staff.

It is expected that in the future, airports, airlines and the third-party platforms, making use of such smart devices as mobile phone, will actively develop various personalized, diversified and differentiated paperless travel services according to passengers' needs and their consumption habits, so as to change development paradigm, optimize products and services as well as improve development quality, expediting the building of an air travel ecological chain under the new situation.

2. Construction of Facilities and Installation of Equipment

In order to comprehensively learn facilities and equipment for paperless travel at domestic airports, on October 22, 2020, CAAC disseminated a *Questionnaire on Paperless Travel Services in the Civil Aviation Industry* and collected feedbacks from 32 airports and 26 airlines.

Table 3-1 List of Sample Airports and Airlines

Category	Name
Airport（32）	Beijing Capital, Beijing Daxing, Shanghai Pudong, Shanghai Hongqiao, Guangzhou Baiyun, Chengdu Shuangliu, Shenzhen Baoan, Kunming Changshui, Xi'an Xianyang, Chongqing Jiangbei, Hangzhou Xiaoshan, Zhengzhou Xinzheng, Wuhan Tianhe, Changsha Huanghua, Qingdao Liuting, Haikou Meilan, Tianjin Binhai, Guiyang Longdongbao, Harbin Taiping, Shenyang Taoxian, Sanya Fenghuang, Dalian Zhoushuizi, Ji'nan Yaoqiang, Nanning Wuxu, Lanzhou Zhongchuan, Taiyuan Wusu, Changchun Longjia, Ningbo Lishe, Wenzhou Longwan, Hefei Xinqiao, Shijiazhuang Zhengding and Yantai Penglai
Airlines（26）	Air China, China Eastern, China Southern, Hainan Airlines, Sichuan Airlines, Shandong Airlines, Shenzhen Airlines, Xiamen Airlines, Juneyao Airlines, Guilin Airlines, West Air, Kunming Airlines, Urumqi Air, GX Airlines, Donghai Airlines, Tibet Airlines, Hebei Airlines, Ruili Airlines, Qingdao Airlines, LJ Air, Chengdu Airlines, Okay Airways, China United Airlines, Joy Air, China Express Air and 9 Air

(1) Airport

Sample airports generally introduced the equipment for self-service check-in and self-service checking baggage, the security check lanes where e-boarding passes were used, as well as the verification equipment at boarding gates, with more than half of these airports applied facial recognition technology.

A. Check-in equipment

As of the end of 2019, sample airports had introduced manual check-in counters, the equipment for self-service check-in and self-service checking baggage and the baggage checking equipment. The details are shown in Table 3-2 below:

Table 3-2 Check-in Equipment at Sample Airports

Category of Equipment	Number of Equipment		
Manual check-in counter	Airports with less than 100 account for 50%（16）	Airports with 100-200 account for 21.9%（7）	Airports with more than 200 account for 28.1%（9）
Self-service check-in equipment	Airports with less than 50 account for 71.9%（23）	Airports with 50-100 account for 3.1%（1）	Airports with more than 100 account for 25.0%（8）
Self-service baggage check	Airports with less than 5 account for 56.2%（18）	Airports with 5-10 account for 12.5%（4）	Airports with more than 10 account for 31.3%（10）

Self-service check-in equipment. All self-service check-in equipment at sample airports had the functions of seat reservation and check-in for domestic flights. Moreover, 46.8% of sample airports deployed self-service check-in equipment which had the functions of seat reservation and check-in for international and regional flights.

Table 3-3 Self-service Check-in Equipment at Sample Airports

Function	Percentage
Seat reservation and check-in for domestic flights	100%（32）
Seat reservation and check-in for international and regional flights	46.8%（15）
Flight segment check-in for transfer passengers	37.5%（12）
Develop e-boarding pass	28.1%（9）
Voice prompts	21.9%（7）
Facial recognition	21.9%（7）
Change/Refund	12.5%（4）
Dynamic flight information search	12.5%（4）
Cabin upgrade	3.1%（1）

Checking baggage equipment. 26 sample airports (81.3%) deployed self-service baggage checking equipment with check-in function. In addition, 12 sample airports (37.5%) used manual check-in counters that provided self-service checking baggage.

B. Security check and border control facilities

As of the end of 2019, all sample airports had deployed security check lanes that supported e-boarding passes. 12 sample airports (41.9%) had equipped with over 30 security lanes and 9 sample airports (29.0%) over 50 ones. Moreover, the paper receipt with security verification stamp had not been used no longer at 25 sample airports (80.6%).

The details are shown in Table 3-4 below:

Table 3-4 Details of Security Check and Border Control Facilities at Sample Airports

Facilities	Percentage	Number of Lanes		
“security check with ID card” (ID card + Facial recognition)	56.3% (18)	50.0% of sample airports with less than 10 lanes (9)	11.1% of sample airports with 10-30 lanes (2)	38.9% of sample airports with over 30 lanes (7)
Border control channels supporting e-boarding pass	37.5% (12)	16.7% of sample airports with less than 5 lanes (2)	58.3% of sample airports with 5-10 lanes (7)	25.0% of sample airports with over 10 lanes (3)

C. Facilities at Boarding Gates

As of the end of 2019, all sample airports had equipped with boarding gates that supported e-boarding passes, of which 59.4% had provided facial recognition:

Table 3-5 Facility Details of Boarding Gates at Sample Airports

Function	Percentage	Number of Lanes		
e-boarding pass	100% (32)	50.0% of sample airports with over 40 lanes (16)	18.8% of sample airports with 40-70 lanes (6)	31.2% of sample airports with over 70 lanes (10)
facial recognition	59.4% (19)	57.8% of sample airports with less than 10 lanes (11)	21.1% of sample airports with 10-70 lanes (4)	21.1% of sample airports with 70 lanes (4)

(2) Airlines

Sample airlines generally implemented online check-in, early check-in and e-boarding passes, and carried out broad scale marketing to promote paperless travel.

A. Software and hardware infrastructure

As of the end of 2019, 26 airlines had provided passengers with off-airport self-service check-in via the airline's official website and its mobile platform or the third-party platform. The details are shown in Table 3-6 below:

Table3-6 Details of Off-airport Check-in of Major Airlines

Channels for check-in and seat reservation	Percentage
official mobile platform	96.2%（25）
official website	88.5%（23）
the third-party platform	80.8%（21）

Off-airport self-service check-in and seat reservation. 15 sample airlines (57.7%) had provided with over 80% of the seats on a single flight for passengers to select via off-airport self-service check-in. The check-in functions are shown in Table 3-7 below:

Table3-7 Details of Off-airport Check-in and Seat Reservation of Major Airlines

Function	Percentage
Check-in cancelling and refund or change after online check-in and seat reservation	84.6%（22）
Online check-in and seat reservation for group or other passengers	69.2%（18）
Online check-in and seat reservation for children’s tickets	69.2%（18）
Online check-in and seat reservation for first class and business class	69.2%（18）
Online check-in and seat reservation for the airlines' employees	34.66%（9）
Online selecting seats in the first row	46.2%（12）
Online selecting seats near emergency exits	26.9%（7）
Automatic check-in service	23.1%（6）

Early check-in function. 23 sample airlines (88.5%) had provided passengers with early check-in. The specific channels are shown in Table 3-8 below:

Table 3-8 Details of Early Check-in of Major Airlines

Channels for Early Check-in	Percentage
passengers who purchase tickets from the airlines' official website	46.2%（12）
the third-party platforms such as Umetrip and VariFlight	42.3%（11）

Use of e-boarding pass. 21 sample airlines (80.8%) had provided e-boarding pass service and its supporting functions at their stations. The details are shown in Table 3-9 below:

Table 3-9 Functions of E-boarding Pass of Major Airlines

Function	Percentage
E-boarding pass with e-verification stamp	80.8%（21）
Automatically send e-boarding pass after check-in and seat reservation	69.2%（18）
"Customs clearance with one pass"	50%（13）
Conduct security check and boarding by facial recognition	30.8%（8）
Check-in and seat reservation by facial recognition	7.7%（2）
E-baggage tag service	7.7%（2）
E-baggage claim service	11.5%（3）

B. Marketing and publicity

25 sample airlines (96.2%) had published relevant tips, introductions and guidelines for paperless travel services through online channels, in-flight magazines and other means. The details are shown in Table 3-10 below:

Table 3-10 Channels Used by Major Airlines to Promote Paperless Travel Service

Channels	Percentage
online channels, such as MicroBlog and WeChat	96.2%（25）
manual check-in counters at the airport and in-flight magazines	61.5%（16）
ticket sales on official website	53.9%（14）

14 sample airlines (53.8%), in cooperation with airports and the third-party ticket sales channels, had carried out marketing and publicity. The details are shown in Table 3-11 below:

Table 3-11 Partners Who Assist Major Airlines in Promoting Paperless Travel

Partners	Percentage
third-party tickets sales platforms	42.3%（11）
airport	50%（13）

3. Application of New Technologies

From the current application of paperless travel in the industry, in addition to e-boarding pass, the paperless mode will become a trend of boarding certificate, information search and identify verification.

(1) Applying for electronic temporary boarding certificate online

For passengers who have expired ID cards or do not carry their ID cards, they may apply for electronic temporary boarding certificate themselves within 1 minute via mini-program on mobile phone anytime and anywhere.

Figure 3-5 Process for Paperless Mode of Temporary Boarding Certificate

(2) Smart flight information service equipment

Making use of smart information service equipment and by facial recognition, passengers will get information, such as flight information, distribution of boarding gates, and enjoy the optimal traffic navigation service that based on GIS system and the online video service, a face-to-face and targeted service. In addition, passengers will also experience consulting services via smart equipment that comprehensively display airport infrastructure, services and maps.

Figure 3-6 Smart Flight Information Service Equipment at Domestic Airports

(3) Facial recognition verification during security check

Passengers may go through security check only with valid second-generation ID card after check-in. In addition, facial recognition technology will be applied in verifying passengers, their identification documents and tickets, which eliminates the deviation caused by manual labor and reduced the workload of security inspectors, improving inspection accuracy and recognition efficiency.

(4) Boarding by facial recognition

Passengers will not need to show boarding certificate in any form and complete boarding by recognizing their faces without any contact.

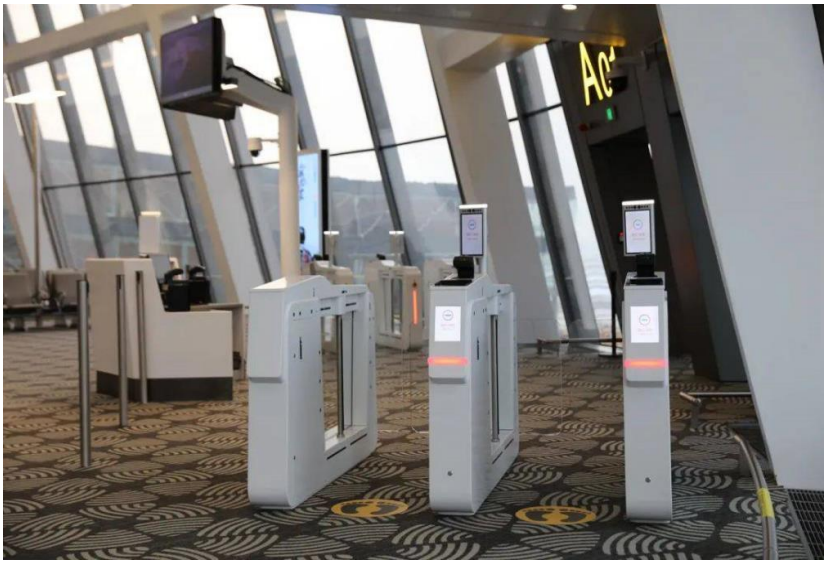

Figure 3-7 Self-service Boarding Equipment at Domestic Airports

(5) Passing border control with QR code

Passengers will receive QR code e-boarding pass after off-airport check-in, and pass border control with it at border inspection lanes without showing any paper certificate. The equipment for border control that recognizes such codes as Aztec, QR and PDF417 meet technical and safety requirements of border control system, and have no effect on normal operation of the traditional system.

(6) Customs declaration service via WeChat

China Customs has introduced the first WeChat mini-program used for customs declaration for inbound and outbound passengers, and vigorously promoted innovative and intelligent supervision of passengers' baggage and items, breaking time and space restrictions on passenger declarations. Passengers will apply to customs in advance according to their conditions at any time before customs clearance to submit relevant declaration information via WeChat. After the airport customs' verification, passengers need to show verification results for customs during customs clearance.

(7) Using of PDA

The airport staff scan QR code by PDA to review passengers' security inspection information at the near and remote aircraft stands. If the information is match, passengers will be allowed to board by passing bridge or taking shuttle bus. PDA has the functions of automatic counting of boarding passengers and verifying their identities, therefore, passengers will not need to show paper ones.

4. Building Information Platform

On December 27, 2017, CAAC promoted paperless travel at airports with an annual passenger traffic over 10 million, with Flight Information APP (Hangxintong) developed by the TravelSky as its technical support platform. With the promotion and application of Hangxintong in the industry, paperless travel services were popularized quickly.

The TravelSky and the National Immigration Administration carried out important cooperation in digitization of international and regional passenger flights which supported the recognition of QR code boarding pass by border inspection entities at entry airports. China's civil aviation took the lead in paperless travel for the flights between China’s mainland and Hong Kong, Macao and Taiwan and international flights for which the Chinese citizens use e-visa, visa upon arrival and visa upon arrival waiver, realizing paperless customs clearance on some international and regional air routes. A total of 13 airlines carried out pilot projects for paperless travel for some international and regional flights at 13 airports with an annual passenger traffic over 10 million, with about 35 000 passengers on international and regional flights enjoying full-process paperless travel services, which saved passengers' travel time, reduced check-in time about 1 hour, and received attention from overseas Chinese, marking a good start for the China's civil aviation industry to improve paperless travel services

for international air routes and the flights between China's mainland and Hong Kong, Macao and Taiwan.

Table 3-12 The Implementation of Paperless Travel Services on International and Regional Flights Originating from Domestic Cities in 2019

Number	Departure Airport	Destination Airport	Airlines	Number	Departure Airport	Destination Airport	Airlines
1	PEK-T3 首都	SYD / MEL (E-visa)	CA	8	HGH 杭州	HKG、MFM (HK/Macao pass)	MU、KA
2	CAN 广州	SYD (E-visa)	CZ	9	NNG 南宁	VTE (visa-on-arrival exemption)	MU
3	SZX 深圳	BNE / ICN (E-visa)	HU、ZH	10	KHN 南昌	TPE (Taiwan pass)	MU
4	CSX 长沙	SYD / HKG (E-visa / HK pass)	HU、KA	11	TAO 青岛	ICN (E-visa)	QW (Umetrip)
5	CTU 成都	SYD / MEL / BKK (E-visa / visa-on-arrival)	3U (Umetrip)	12	XMN 厦门	SYD、CNS (E-visa)	MF CX (test)
6	KMG 昆明	SYD / BKK / PNH (E-visa / visa-on-arrival)	MU、HU、8Y	13	CKG 重庆	MEL/VTE/KTM (E-visa / visa-on-arrival)	GS、G5 (Umetrip)
7	HAK 海口	MEL (E-visa)	HU				

IV. Boosting COVID-19 Prevention and Control

Since 2020, thanks to the regular COVID-19 prevention and control measures, the implementation of paperless travel has effectively reduced unnecessary contacts among passengers, airlines' staff and ground handling personnel that exist in traditional travel mode, as well as avoided passengers gathering before manual check-in counters or self-service check-in equipment, offering a strong support for the safe air travel of passengers and the scientific epidemic containment by airlines.

1. Effectively Reducing Contacts Among People

Amid the COVID-19, the implementation of paperless travel at some airports not only reduced check-in time and enhanced the efficiency of air travel, but also reduced contacts between passengers and airport personnel resulting in decrease of infection risks, which played a positive role in the COVID-19 prevention and control. In 2020, due to COVID-19, the passenger traffic dropped across the industry, however, passengers preferred to self-service check-in during air travel over COVID-19 concerns. According to statistics, in 2020, the average percentage of passengers who chose self-service check-in at airports with an annual passenger throughput of over 10 million increased to 72.2%.

Figure 4-1 Paperless Travel Mode Plays an Important Role during COVID-19

For example, **Beijing Capital Airport** and **Beijing Daxing Airport** actively promoted the whole-process paperless flight services that based on facial recognition technology. Passengers will only need to show their boarding passes at security checkpoints once to correlate their faces with flight information. When boarding, they will only need to recognize their face by the machine without any boarding passes, which effectively avoided cross-infection.

Figure 4-2 Hangxintong + APP and Self-service Boarding Gate with Facial Recognition

Figure 4-3 Smart Flight Information Equipment and Self-service Information Inquiry Equipment at Beijing Daxing Airport

Meanwhile, **Beijing Capital Airport** and **Bejing Daxing Airport** have integrated facial recognition technology with airport scenarios and applied in-building location and navigation technology to provide passengers with information search services by facial recognition, realizing contactless interaction with passengers. For instance, at Beijing Capital Airport, electronic payment has been popularized at its all terminals, with QR code for taking order at restaurants. Working with Eleme takeout platform, Beijing Daxing Airport carried out takeout services to make passengers enjoy food delivered within 30 minutes at boarding gate.

2. Helping Epidemic Prevention and Control as well as Contact Tracing

During COVID-19, the implementation of paperless travel enabled airlines, airports and other relevant entities to access passengers' identities and contact information in advance, which assisted the National Health Commission in tracking passengers' journey and tracing their contacts, and made important contributions to the screening, tracing, control and quarantine of personnel.

In 2020, Beijing Capital Airport and Beijing Daxing Airport introduced infrared devices for instant screening of body temperature, with the functions of automatic calibration, facial recognition, tracking and snapping, automatic storage as well as body temperature monitoring of large passenger flow, making passengers who got in and out the airport without being disturbed. In addition, the contactless devices for screening body temperature had been allocated at both airports to strengthen body temperature monitoring of passengers who enter and leave the terminals and parking buildings, so as to instantly screen passengers' body temperature and alert abnormal body temperature in real time, which not only improved accessibility efficiency at exits and entrance, but also reduced infection risk of testing personnel at airports.

体温筛查系统　　测温门

Figure 4-4 Body Temperature Screening System at Beijing Capital Airport

In addition, Beijing Capital Airport deployed an investigation system for tracing close contacts to investigate traces of confirmed cases and identify their contacts. Using existing high-definition cameras and facial recognition algorithm, the system will trace individual confirmed cases and their contacts in just 1 minute, and complete manual verification to identify locations within about 20 minutes. By the end of 2020, the airport had found out 70 confirmed cases by using the system for the CDC and some airport hospitals.

Figure 4-5 The Contact Trace Investigation System Adopted at Beijing Capital Airport

In the later period of the COVID-19 in 2020, Beijing Capital Airport developed an Internet + body temperature taking system to further detect abnormal body temperature. Making use of the existing hardware facilities and body temperature taking process, as well as applying artificial intelligence technology, the system was capable of automatically capturing faces and taking body temperature, automatically recording data, synchronizing alarm information and searching data via computer and mobile phone, which enhanced detection accuracy of abnormal body temperature, improved passage efficiency and reduced the workload of front-line personnel with existing body temperature screening process remaining unchanged.

Figure 4-6 Internet + Screening Body Temperature System Introduced at Beijing Capital Airport

3. Optimizing Services and Products for Passengers

During COVID-19, some airports and airlines made innovations to provide passengers with various paperless services and products, including ticket refund and change, compensation for flight delays and One ID initiative, making passengers' travel more convenient and rapid.

Many airlines streamlined the refund and change process to ask passengers to send electronic version of relevant materials via email instead of sending paper ones by the mail, which improved the refund efficiency and the satisfaction of passengers. For example, to further enhance payment for compensation and reduce financial management risks, **Sichuan Airlines** introduced a payment system for compensation for flight delays at Chengdu Airport. In order to meet the target of "independent application by passengers, automatic review by the system, and automatic payment for compensation", a unified payment platform in the system was set up to directly pay for compensation to passengers' own bank accounts via the airlines' WeChat account and the third-party platforms, such as UnionPay and WeChat.

Figure 4-7 Paperless Payment for Compensation for Flight Delays Introduced by Sichuan Airlines

In addition, many airlines and airports introduced various paperless services and products, such as online voluntarily health report and online check-in via their websites, APPs and WeChat accounts to provide with passengers a safe and convenient travel, which laid a foundation for passengers preference to paperless travel in the post-COVID-19 era.

Figure 4-8 Online Check-in + Online Health QR Code Check via APP

Figure 4-9 Example of Online Voluntarily Health Report via APP when Reaching the Destination

Beijing Capital Airport developed a VR guiding system designed for transfer passengers and shared the airport's service information via its APP and the third-party platforms. The system provided different customized services, such as flight information search, airport layout guidance and indoor positioning, public transport information inquiry and health QR code check, as well as quick and accurate positioning of passengers' vehicles with facial recognition technology.

Figure 4-10 Smart Parking System at Beijing Capital Airport

Beijing Daxing Airport developed Daxing Airport APP to provide the contactless and whole-process paperless services as follows: first, the one-stop travel service information, which made accessible the status of passenger queue, baggage tracking and the comprehensive transport information, and enabled such offline services as Baggage Delivery Service and special services reservation available online; second, the whole-process customized services available for different travel scenarios, which integrated all information and services needed from home door to cabin door; third, the

online shopping mall, takeout services, as well as the customized commercial preferential plans aimed at differential consumption demands of passengers, which helped to create a new aviation city that integrated with business.

Figure 4-11 One-stop Service APP Introduced by Beijing Daxing Airport

Beijing Daxing Airport also provided paperless services designed for parking and airport shuttle bus. Passengers will purchase bus ticket via the airport's WeChat account, pay for parking fee using different methods, such as Daxing Airport APP, self-service payment equipment at parking lot or swiping QR code, and acquire electronic invoices online. In addition, they could use their ID cards to register information to take airport bus, which avoided close contact between staff and passengers and improved the airport’s service efficiency.

Figure 4-12 Daxing Airport's Payment for Parking Fee APP and Self-service Airport Bus Ticket Vending Equipment

The Capital Airport Holding Company (CAH) developed the first special APP that was applied to its member airports in China, which provided personalized online services, such as online QR code ordering, online check-in, baggage delivery and VIP lounge reservation, covered eight main airports of the Group, and connected to different service networks, allowing passengers to enjoy more convenient travel experience.

4. Improving Services for Special Passengers

During COVID-19, some airports improved their services for the special passengers including the elderly in addition to measures to prevent and control of COVID-19, providing an efficient, smooth and comfortable travel experience for passengers.

For example, **Beijing Capital Airport** established the Service Standards for the Elderly of Airport Selected Special Staff, and the Special Services Designed for the Elder Passengers. With these services, the elderly and the passengers who have difficulty in applying for health QR code will enjoy a smooth travel by using special channels without using health QR code. The airport also equipped with both self-service check-in equipment and manual check-in counters to enable the elder passengers to select the ways of check-in and checking baggage suitable for themselves, as well as developed an intelligent customer service system, based on voice recognition, natural language understanding and voice synthesis technology to provide with them convenient online services.

Figure 4-13 Paperless Services for Special Passengers Provided by Beijing Capital International Airport

During the epidemic, **Beijing Daxing Airport** carried out health QR code check services for the elderly, the passengers who do not have phones and unaccompanied children by using portable check devices to verify their health QR codes at the entrance/exits where large traffic flow occurred.

Figure 4-14 Paperless Services for Special Passengers Implemented at Beijing Daxing International Airport

Besides, to ensure rapid passage of the elderly, **Nanchang Airport**, working with the airport bureau of aviation security, established a rapid check system and arranged the airport staff to register identity information of the elderly to check their travel traces with ID card, which eliminated the need for the elder passengers to fill in written form. The airport also launched a reservation service for special passengers, by which special passengers, such as the elderly, will book some services free of charge, including seat selection, using wheelchair, flight information consultation and whole-process escort service via WeChat, telephone and other channels.

V. Social and Economic Contribution

As mentioned earlier, the promotion of paperless travel in the industry will not only bring social and economic contribution to the passengers, the entire industry and even the society, including saving passengers' time, cutting down investment in the paper and equipment related to air travel, and reducing carbon emissions, but also promote the transformation and upgrading of the whole-process travel by simplifying its process and improving its efficiency.

1. Basis and Methods of Estimation

In general, the paperless travel has the advantages of saving passengers' time, cutting down cost of printing boarding pass, and reducing investment in hardware and software infrastructure. Meanwhile, it serves as an important way for airlines to perform their social responsibilities such as reducing carbon emissions and protecting the environment. The specific basis for estimate is shown in Table 5-1 below.

Table 5-1 Estimation of Cost Saving by Implementing Paperless Travel

No.	Social and Economic Contribution	Basis for Estimation
1	saving passengers' time	by the paperless travel, about 1 hour and 1.5 hours on travel for domestic and international passengers will be reduced respectively
2	saving cost of printing boarding passes	cost of paper boarding pass=0.2 yuan/piece
3	reducing investment in airport software and hardware infrastructure	375 self-service check-in equipment have to be used for printing 100 million boarding passes throughout the year (the rate of equipment renewal)
4	reducing carbon emissions	printing 100 million paper boarding passes≈1500 ton carbon emissions

2. Evaluation of Contribution to the Society and Economy

(1) Prediction about the popularity of paperless travel

In practice, with regard to the contribution of paperless travel to the society and economy, many factors needed to be considered, including the passenger traffic and its growth rate, and the popularization of paperless travel services across the industry. Considering the operation of the industry in 2019, the impact of the epidemic in 2020, the 14th Five-year Plan for the civil aviation industry, as well as the implementation of paperless services, it is estimated that during the 14th Five-year Plan period, there will be 2 billion domestic passengers and 5 million international passengers enjoy paperless travel services.

Table 5-2 The Popularization of Paperless Travel Services

Year	Domestic Air Routes (Hong Kong, Macao and Taiwan not included) (100 million passengers)	International and Regional Air Routes (10 thousand passengers)	Total (100 million passengers)
2019	3.3	142.8	3.3
2020	2.4	-	2.4
2021	3.5	90.0	3.5
2022	3.8	95.0	3.8
2023	4.0	100.0	4.0
2024	4.2	105.0	4.2
2025	4.5	110.0	4.5
Total (14th Five-year Plan period)	25.7	642.8	25.8

(2) Reduction in Time Cost

Generally, passengers had to arrive at the airport 2 hours or 2.5-3 hours before departure to go through check-in for domestic or international flights respectively. In the light of experiences, it was estimated that the average time for processing paper boarding passes was 7 minutes per passenger by manual check-in counters and self-

service check-in equipment. Considering the time of passenger queue, seat selection, and printing, each passenger who took domestic flights or the international and regional ones would respectively save 1 hour or 1.5 hours on average by enjoying paperless travel services. As a result, based on preliminary estimates, 580 million hours had been saved for passengers from 2019 to 2020. During the 14th Five-year Plan period, it is estimated that about 2.58 billion hours will be saved for passengers.

Table 5-3 Estimation of Time Reduction by Implementing Paperless Travel

Year	Domestic Air Routes(Hong Kong, Macao and Taiwan not included) (100 million hours)	International and Regional Air Routes (10 thousand hours)	Total (100 million hours)
2019	3.3	214.2	3.4
2020	2.4	-	2.4
2021	3.5	135.0	3.5
2022	3.8	142.5	3.8
2023	4.0	150.0	4.0
2024	4.2	157.5	4.2
2025	4.5	165.0	4.5
Total (14th Five-year Plan period)	25.7	964.2	25.8

(3) Reduction in paper cost

With the popularization of paperless travel services in passenger transport, the investment in paper resources will be significantly reduced across the industry. In the light of experiences, the cost of paper boarding passes spent by every passenger for his/her each trip was about 0.2 yuan per sheet. As a result, based on preliminary estimates, 120 million yuan of paper costs had been saved for airlines and airports from 2019 to 2020. During the 14th Five-year Plan period, it is estimated that a total of 400 million yuan will be saved for airlines and airports.

Table 5-4 Reduction in Paper Cost by Implementing Paperless Travel

Year	Domestic Air Routes (Hong Kong, Macao and Taiwan not included) (100 million yuan)	International and Regional Air Routes (10 thousand yuan)	Total (100 million yuan)
2019	6667.5	42.8	6710.3
2020	4800.0	-	4800.0
2021	7000.0	27.0	7027.0
2022	7600.0	28.5	7628.5
2023	8000.0	30.0	8030.0
2024	8400.0	31.5	8431.5
2025	9000.0	33.0	9033.0
Total (14th Five-year Plan period)	51467.5	192.8	51660.3

(4) Cutting down investment in software and hardware infrastructure

The popularization of paperless travel services will effectively reduce the investment of airlines and airports in software and hardware infrastructure. In the light of experiences, about 375 self-service check-in equipment were used for printing 100 million boarding passes a year, with the cost of each one being about 200 to 300 thousand yuan. As a result, if its average cost was 250 thousand, based on a preliminary estimation, 310 million yuan had been saved for the entire industry from 2019 to 2020. During the 14th Five-year Plan period, it is estimated that a total of 110 million yuan will be saved.

(5) Reducing carbon emissions and protecting the environment

The paperless travel services will effectively reduce carbon emissions and comprehensively put into practice of the concept of national green development by decreasing the use of paper. It is estimated that every 100 million paper boarding passes will produce about 1500 tons of carbon dioxide. As a result, according to preliminary estimates, 8 622 tons of carbon dioxide had been reduced from 2019 to 2020. During the 14th Five-year Plan period, 30 075 tons of carbon dioxide are expected to be effectively reduced. If measured in terms of vehicle emissions, a 1.6 L vehicle with mileage of 20 000 km per year will produce 5.4 tons of carbon dioxide, which is equivalent to a reduction of 1 597 vehicles (1.6 L) carbon emissions for nearly a year from 2019 to 2020. During the 14th Five-year Plan period, it is estimated that the total annual carbon emissions of 5 570 vehicles will be reduced, indicating that the paperless travel services play a positive role in reducing carbon emissions and protecting the environment.

(6) Summary

From 2019 to 2020, 570 million passengers had enjoyed paperless travel services, reducing 580 million hours for passengers and saving 430 million yuan on paper and investment for airlines and airports. The industry effectively reduced 8 622 tons of carbon dioxide equivalent to the total carbon emission of 1 597 vehicles (1.6 L) a year, achieving remarkable social and economic benefits. Looking forward to the next five years of the 14th Five-year Plan period, the implementation of paperless travel in the industry will bring forth benefits to the society as follows:

- During the 14th Five-year Plan period, more than 2 billion people across the country will enjoy paperless travel services.
- During the 14th Five-year Plan period, the implementation of paperless travel will reduce more than 2 billion hours spending on check-in for passengers, enabling passengers to control their travels freely.
- During the 14th Five-year Plan period, the implementation of paperless travel will save more than 400 million yuan spending on paper, facilities and equipment for airlines and airports.

- During the 14th Five-year Plan period, the implementation of paperless travel will effectively reduce 30 075 tons of carbon emissions across the industry, or about the total emission of 1 114 vehicles (1.6 L) per year.

VI. Prospects for Future Development

Paperless travel has not only changed the existing concept and mode of air travel services, increased passengers' control of their journeys, enhanced passengers' willingness to travel, and tapped into the potential of air transport market, but also expedited the transformation and upgrading of traditional air travel services, and helped the overall digital and electronic transformation of passenger services in the industry both in China and across the globe. With the improvement of electronic, information and intelligent technologies in the future, the paperless travel services will take a lead in creating new demand with innovation-driven and high-quality supply, providing a theoretical and practical basis for China's civil aviation to achieve high-quality development and to speed up the building of a civil aviation powerhouse in the new era.

1. Adhering to the Provision of Both Traditional and Intelligent Services

There is no conflict between the intelligent services and the traditional ones. In fact, two types of services are complementary to each other. Even in the future, traditional services will not disappear with the popularization of intelligent technology. On the contrary, thanks to intelligent technology, traditional services will tend to be more humanized and convenient. Therefore, in the future, the aim of intelligent services should on passengers' sense of fulfillment and well-being to enable air travel to be more convenient for air passengers, and more attention should be paid to the demand for travel of special groups including the elderly, children and pregnant women, especially those elderly who are not good at using smart devices, so as to provide more professional and customized traditional services.

In the future, for different passengers, there will be more personalized and differentiated services, more and more online and offline services, and more humanized traditional service counters and special passenger channels to meet high-quality demand for travel of special passengers such as the elderly. The airport will predict passenger demand in advance by using big data when such special passengers as the elderly bought ticket, to provide more refined and targeted services. At the same time, special passengers including the elderly who will enjoy targeted and personalized travel services by online booking or offline selection. For example, the elderly can ask for using trolleys and taking wheelchairs for boarding at manual check-in counter, for shortening waiting time at security checkpoints, as well as for enjoying services such as priority boarding, and for assistance in reaching the seats and in arranging luggage to make their boarding smoothly.

2. Continuously Promoting the Development of Airports with Four Salient Features, i.e., Safety, Green, Intelligent and Humanistic

Paperless travel not only has an impact on passengers, airlines and airports, but also has great significance for the development of airports with four salient features, i.e., safety, green, intelligent and humanistic, as well as the evaluation of service quality in the industry. In 2020, CAAC issued *Guidelines for the Development of Airports with Four Salient Features, i.e., Safety, Green, Intelligent and Humanistic* to the industry, which laid down detailed top-level guidance and overall planning for the development path of China's airports in the future, and established a path of airport modernization. In the Guidelines, for the construction of intelligent airports, requirements in six areas were put forward including networking, visualization, collaboration, intelligence, individualization and refinement which were closely bound up with the popularization and application of paperless travel services in the industry. It was worth mentioning that the promotion of paperless travel services enabled airports to focus on investment in leisure, entertainment and culture facilities at the airports, enhance the humanistic care and cultural atmosphere of the airports, creating personalized and humanistic airports.

During the 14th Five-year Plan period, with deepening application of the notion of airports with four salient features and the acceleration of airport construction, and the implementation of paperless travel in the industry will continuously promote the upgrading of service products and of development quality for the whole industry. Therefore, there will be new requirements for improving and optimizing the index system for evaluating civil aviation service quality. Considering current situation and requirements of industry development, the evaluation indicators related to intelligent services, such as paperless travel services, air-rail joint transport, transfer and baggage tracking will be incorporated into the industry service quality management system step by step, so as to enhance the overall image of the civil aviation industry and promote the building of China's civil aviation brand.

3. Improving Standards for Applying New Technologies and Supporting Regulatory and Policy System

With the rapid application of new technologies in the industry, further improvement of the regulatory system for related technology standards has also been put on the agenda, especially the collection and use of private information such as human face which is closely related to passengers' information security and protection. In 2021, the State Council issued a draft of national standards, *Requirements of Safeguarding Facial Recognition Data by Using Information Security Technology*, to solicit opinions from the society, which strictly restricted on the collection and using of passengers' biological data, and particularly on typical application scenarios such as airports and railway stations. Consequently, CAAC will carry out research on the standards and its supporting regulatory policies, and regulate commercial applications of facial recognition information by airports and airlines. For example, enterprises shall not store and transfer written authorization provided by passengers as required, and carry

out user profile analysis, so as to further protect passengers' privacy and promote the standardized application of new technologies in the industry.

Looking forward into the future, China's civil aviation will apply new technology and new mode, taking paperless travel, transfer facilitation services, full-process baggage tracking and air-rail transport as the starting point to solve difficulties and make effective efforts for the people, to continuously enhance the people's sense of fulfillment and well-being in their travel, and to promote high-quality development of civil aviation.