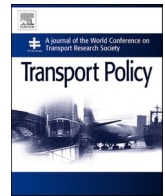




Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# Sustaining aviation workforce after the pandemic: Evidence from Hong Kong aviation students toward skills, specialised training, and career prospects through a mixed-method approach

Cho Yin Yiu<sup>a</sup>, Kam K.H. Ng<sup>a,\*</sup>, Simon C.M. Yu<sup>a</sup>, Chun Wah Yu<sup>a,b</sup>

<sup>a</sup> Aviation Research Consortium, Department of Aeronautical and Aviation Engineering, The Hong Kong Polytechnic University, Hung Hom, Hong Kong SAR, China

<sup>b</sup> Division of Science, Engineering and Health Studies, School of Professional Education and Executive Development, The Hong Kong Polytechnic University, Hung Hom, Hong Kong SAR, China

## ARTICLE INFO

### Keywords:

COVID-19  
Aviation students  
Aircraft maintenance engineering  
Licensed training  
Career prospects

## ABSTRACT

The aviation industry is in a recession with the rapid and immense outbreak of COVID-19 under globalisation. The future young aviation professionals might suffer from a ‘career shock’. This study analysed the post-pandemic career prospects for Hong Kong aviation students using mixed-method research considering specialised and licensed training. We conducted a survey (N = 101) and focus group interviews (N = 6) to investigate students’ perceived impediments and potential support from the institutions. Matt-Whitney *U* test is used to compare the perceptual difference in the impediments, career prospects, skills required, and institutional supports between (non-)specialised training students, (non-)engineering-related students, and (non-)final-year students. The results demonstrated no significant difference between students with and without specialised training. While final-year students perceive themselves as lacking more in terms of non-technical skills than non-final-year students, students are interested in broadening their career options to include airline operations, aircraft engineering and maintenance via acquiring a variety of emerging knowledge and technical skills. Given most studies focus on the recovery pattern of the aviation industry, this study is original in considering Hong Kong aviation students’ career impediments and prospects using a mixed-method approach to provide policy insights.

## 1. Research background

Globalisation in the 21st century made the COVID-19 outbreak rapid and immense. As the cornerstone to support most international travel activities, the aviation industry is in a recession (Suau-Sanchez et al., 2020; Sun et al., 2020). Before the pandemic, the IATA (2017) forecasted nearly 80,000 additional positions would be opened by the industry’s growth trend in 2017. Ideally, more than 300,000 jobs could be supported by the growing trend. The Hong Kong International Airport’s third runway was completed in 2021 and commissioned in 2022, which is expected to create new job opportunities in the aviation sector. However, the IATA (2020) predicts the air transport volume will return to the 2019 level in 2024. Rothengatter et al. (2021), however, concluded that the trimmed confidence of passengers would cause difficulties in returning to the pre-pandemic expected growth for mass transportation modes. Per the ongoing development of the pandemic

and the abrupt disruption to the industry, most companies find it hard to maintain their operations status quo (Belsler and Prescod, 2021). After the pandemic had lasted for three-fourths of a year, Cathay Dragon shut down due to its financial incapability (Lee, 2020). The widely imposed border restrictions made Hong Kong Express suspend all flight operations. Expenses could also be trimmed by laying off subordinates and/or enforcing mandatory no-pay leave. It is difficult to make a proper reaction to such a devastating event.

To let young talent shine, job vacancies for junior staff are particularly vital to recent aviation graduates and current students. Nonetheless, the recruitment process for new staff has been suspended for many aviation companies to relieve their financial stress. In 2020, Hong Kong’s flag carrier Cathay Pacific eliminated 2,600 unfilled roles (Lee and Magramo, 2020). During the pandemic, airlines based in Hong Kong, such as Cathay Pacific and Hong Kong Airlines, have trimmed their headcounts by around 5,900 posts globally and about two-thirds,

\* Corresponding author.

E-mail addresses: [james-cho-yin.yiu@connect.polyu.hk](mailto:james-cho-yin.yiu@connect.polyu.hk) (C.Y. Yiu), [kam.kh.ng@polyu.edu.hk](mailto:kam.kh.ng@polyu.edu.hk) (K.K.H. Ng), [simon.c.yu@polyu.edu.hk](mailto:simon.c.yu@polyu.edu.hk) (S.C.M. Yu), [savio.yu@speed-polyu.edu.hk](mailto:savio.yu@speed-polyu.edu.hk) (C.W. Yu).

<https://doi.org/10.1016/j.tranpol.2022.09.020>

Received 12 March 2022; Received in revised form 30 August 2022; Accepted 16 September 2022

Available online 20 September 2022

0967-070X/© 2022 Elsevier Ltd. All rights reserved.

respectively (Lee and Choy, 2021; Lee and Magramo, 2020). As a multicultural hub, Hong Kong’s tourism, trading, and logistics industries, with a long and good track record in transshipping cargo between regional and international, are critical. In 2019, these industries contributed nearly one-fourth of Hong Kong’s gross domestic product (GDP) (Census and Statistics Department, 2021). Indeed, the aviation industry is critical in maintaining such a status. Yet, the suspension of the recruitment process and internship experiences might cause substantial disturbance to their career plan. Vocational training is extensively applied to nurture the next generation of professionals, like the on-the-job training adopted to train practical skills-oriented occupations such as nurses (Canet-Vélez et al., 2021). Such disturbances might result in a ‘career shock’ as students might not expect the graduation job market to deteriorate dramatically upon graduation (Akermans et al., 2020; Wright et al., 2021).

Several higher education institutions in Hong Kong attempt to integrate Government-accredited training into their tertiary programmes. Notably, licensing is widely adopted in aviation for authorising a person who demonstrates an internationally accepted degree of competency to carry out relevant aviation tasks. For instance, the HKAR-147 training is a professional training at tertiary-level education that could be embedded in the undergraduate studies for students to become an HKAR-66 licensed aircraft maintenance engineer, an internationally benchmarked framework that conforms to ICAO Annex 1 (Yadav, 2010). This training provides an accelerated path for students to acquire the HKAR-66 Category B1 (Mechanical)/B2\* (Avionics) Line Maintenance Certifying Engineer basic license, where students could be licensed as fast as six years when compared to the normal track of nine years (see Fig. 1).

The demand for aircraft maintenance personnel is high globally. Thus, a shortage would likely impede usual air traffic operations (Silk, 2022). In the United States, the number of aircraft maintenance licenses issued in 2020 trimmed by 30% compared to 2019, accounting for the lowest value in the past two decades (Aviation Technician Education Council, 2021). In the Greater Bay Area, the recently signed Cooperation Arrangement on Joint Maintenance Management (JMMCA) between the Civil Aviation Department (Hong Kong), Civil Aviation Administration of China (China), and Civil Aviation Authority of Macao (Macau) offers the HKAR-66 license holders a broader career prospect. Under the newly signed JMMCA, aircraft maintenance licenses issued by either authority under the Cooperation Arrangement (in accordance with HKAR-66/CCAR-66/MAR-66) are recognised in all three places. Therefore, holders of either a Hong Kong, China, or Macau license could work as maintenance certifying staff in all states under the Cooperation Arrangement. With the surging collaboration in the Greater Bay Area, graduates under the HKAR-147 embedded programmes in Hong Kong shall be able to pursue their careers in non-local aircraft engineering organisations without the need for conversion or re-examination. The pandemic might also mitigate several outsourced maintenance tasks of local and the Asia Pacific airlines onshore in Hong Kong. Given all these opportunities and characteristics, the HKAR-147 training provides a relatively clear career path in aircraft maintenance engineering (Usanmaz, 2011), raising students’ competitiveness in exchange for slightly lowering occupational mobility to anticipate future challenges.

Especially, under the impact of the pandemic, the trimmed occupational mobility might lead to a career shock and impede their future development. Hence, the perceived impediments and career prospects of HKAR-147 students, equipped with specialised and licensed training, deserve further investigation.

The rest of the paper is organised as follows: Section 2 outlines several research questions based on a comprehensive literature review on career shock and changes in the aviation industry and technological development. Section 3 illustrates our methodology of data collection. Section 4 presents the results, the discussions of the results, and managerial insights. The conclusions, limitations of this study and potential future works are presented in Section 5.

## 2. Literature review

### 2.1. Career shock and anxiety

A career shock is defined as “a disruptive and extraordinary event that is, at least to some degree, caused by factors outside the focal individual’s control and that triggers a deliberate thought process concerning one’s career” (Akermans et al., 2018, p. 4). The COVID-19 pandemic serves as a disruptive event that would likely trigger a deliberate thought process on careers for aviation students. The key attributes of a career shock are frequency, foreseeability, valence, duration, and source. Andaregie and Astatkie (2021) assessed the pandemic’s impact on job security levels in Ethiopian colleges during the lockdown and revealed age as a significant factor. In the hospitality industry, Jung et al. (2021)’s study concluded job insecurities and reduced job engagement arise from potential layoff plans. Particularly, a low level of job engagement likely causes higher turnover intent. Therefore, as aviation job insecurities surface during the pandemic, job engagement is likely to be trimmed, resulting in an unstable post-pandemic workforce.

Thus, career shocks might cause students to question their future career path when the industry is under recession (Fraher and Gabriel, 2014). Particularly, for HKAR-147 trainees, their occupational mobility is likely to be lower, which in turn resulting in a higher level of career shock. Consequently, forced pursuance of alternative career pathways might lead to potential anxiety (Sullivan and Al Ariss, 2021). Nevertheless, young professionals equipped with specialised knowledge in aviation are the cornerstone of sustaining the aviation industry (Gómez et al., 2022). Therefore, the anxiety brought by the COVID-19 pandemic shall be adequately addressed to retain young professionals for the industry’s sustainable development.

### 2.2. Post-pandemic reformations and challenges for a resilient aviation industry

The pandemic has made lots of changes, from business and international travel to video conferencing and local tours. Yet, when the industry recovers, deep-rooted reformation like the incorporation of emerging technologies such as unmanned aerial systems (UAS) (Tisdall and Zhang, 2020; Weissbach and Tebbe, 2016). Albers and Rundshagen (2020) denoted that there will be permanent changes to the aviation industry, and the corresponding required skill sets for one to develop

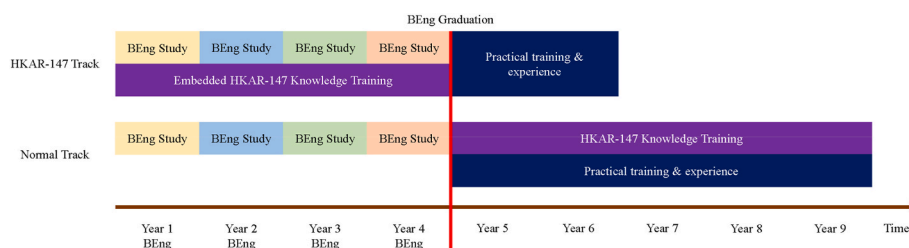


Fig. 1. A comparison of aircraft maintenance engineer training between the HKAR-147 and the normal track.

their career would also change. Therefore, continuous skills development and professional training are expected to be highly integrated with the career pathway of an individual. Sun et al. (2021) initiated three technological challenges that the industry shall address to become pandemic-resilient and sustainable, including smarter aircraft with flexible cabin layout and novel design, smarter airports with touchless experience and integration with the Internet of Things, and smarter airlines with digitised passenger data management and artificial intelligence-based operations. Therefore, industry practitioners, as well as aviation students, shall also be equipped with timely and updated skill sets to cope with the rapid technological advancements in the industry.

### 2.3. Role of vocational training and skills required for pandemic-resilient workforce

Vocational training is commonly used to nurture the next generation of aviation professionals. From pilots, air traffic control officers (ATCOs) to aircraft maintenance professionals, on-the-job training is essential for building a solid foundation (Yiu et al., 2022). Though training is essential to cope with the future challenges of the industry (Hogan et al., 2021; Yiu et al., 2021a), there are numerous specialisations and skill sets that could be pursued (Aničić and Bušelić, 2021). Several novel skills that are receiving emerging emphasis, including UAS (Henderson, 2022; Weissbach and Tebbe, 2016), airline administration and operations management, air logistics and cargo management (e.g., Dangerous Goods Regulations), pilot ground theory, and non-technical skills such as customer service management, and organisational management and leadership. Sun et al. (2021) also advocated three aviation education initiatives: smarter skills with systematic thinking and social responsibility, smarter learning via virtual and engaging means, and smarter careers on multiple specialisation and lifelong learning. Higher education institutions are expected to play a significant role in equipping their students with the aforementioned technical skills to fulfil the industry's needs (Fullingim, 2011), as well as arming their students with non-technical skills, e.g. communication, teamwork, leadership and management (Miani et al., 2021). While the construction of the third runway of the Hong Kong International Airport and the recently signed China-Hong Kong-Macau JMMCA may foster a better aviation labour market, students need to develop appropriate skill sets to be resilient in the long term. Thus, universities play a crucial role in providing proper curriculum tuning to help students to adapt to the ever-changing environment during the 'career shock'.

### 2.4. Research gap

While most tourism and aviation management literature attempt to recognise the pattern of travel behaviours under the pandemic (Lamb et al., 2020; Zenker and Kock, 2020; Zhang et al., 2020) and the anticipation of the industry's future recovery (Czerny et al., 2021; Dube et al., 2021; Tisdall et al., 2021; Yiu et al., 2021b; Zhu et al., 2021), there is an absence of sufficient literature studying the prospects and impediments that students in an aviation-related programme face in the post-pandemic times. Especially, the lack of qualitative opinions and evidence hindered the alignment of local policies and resources to strengthen the position of Hong Kong as an aviation hub. The low occupational mobility has made alternative career decisions difficult, especially for the HKAR-147 trainees under the pandemic. This study contributes by revealing the impediments of post-pandemic career development and career prospects of Hong Kong tertiary aviation students via a mixed-method study. It is noteworthy that anti-pandemic policies related to discouraging human mobility mainly cover border closures, visa invalidation, and quarantine measures. Therefore, this study is particularly interested in the post-pandemic ages: the time that the abovementioned policies would have been revoked or, at least, mitigated to a level that will not discourage the general public from travelling through aviation. This study extends Miani et al. (2021)'s

study conducted in Australia to the context of Hong Kong, aiding the development of insights from mixed-method research and a different cultural context. Theoretically, this study fills the gap in the understudied area of aviation education and training: most studies focus on analysing business-related topics, such as forecasting the recovery and investigating social changes. However, few studies focus on how aviation students were impacted by these social changes and recovery patterns, especially those under specialised training. The insights gained could assist higher education institutions in aligning their resources properly to maximise students' benefits and sustain the aviation industry with their policies. Comparison is also drawn between different sub-categories of aviation students. Thus, the core research questions of this study are:

1. What personal and external impediments hinder Hong Kong aviation students' career development?
2. What skills do Hong Kong aviation students consider essential in continuous development?
3. What alternative career/study options would Hong Kong aviation students consider?
4. How can higher education institutions better align their resources to maximise their students' benefit?

## 3. Research methodology

### 3.1. Mixed-method research design

In this study, a mixed-method research design is adopted. The survey provided quantitative results, and qualitative support was drawn from the focus group participants. Using the follow-up explanations model of the explanatory design, the qualitative evidence obtained in focus group interviews aided the interpretation of the quantitative results (Creswell and Plano Clark, 2007). Fig. 2 shows the roadmap of the current study.

### 3.2. Survey

#### 3.2.1. Questionnaire construction

The participants were asked for a total of 32 items. The questionnaire was developed based on Miani et al. (2021)'s study, in which they consulted an airline senior management focus group regarding the essential skills required for graduates. Aligning with Miani et al. (2021), the items were developed based on a consolidation of skills required from a variety of related air transport literature, relevant programme curriculum in Hong Kong, and data under the COVID-19 pandemic. Several modifications are also made to suit the Hong Kong context, e.g., flying majors being available in Australia but unavailable in Hong Kong. Moreover, maintenance-related careers are more common in Hong Kong, as evidenced by the Graduate Employment Survey of Hong Kong local institutions. Therefore, we modified Miani et al. (2021)'s questionnaire to suit the context of Hong Kong.

Hence, the survey is divided into six sections. The first section is related to personal impediments, consisting of eight items. These items include students' financial status, perceived lack of skills, intention to pursue alternative careers, and the role of significant others, mainly adopted from Miani et al. (2021). The following section consists of seven items on external impediments, covering objective pandemic control policies, available vacancies, and perceived post-pandemic development of the industry, also modified from Miani et al. (2021). The third section highlights the importance of emerging knowledge and technical skill sets with seven items, covering a variety of aviation-related skills and knowledge that would be practical in Hong Kong. These skills and knowledge are selected after consulting industry practitioners. The fourth section covers five items on the perceived possible future area of career/studies, comprised of different possible post-graduation options. The second-last section consists of five items on the importance of various post-COVID-19 support from the universities, adapted from

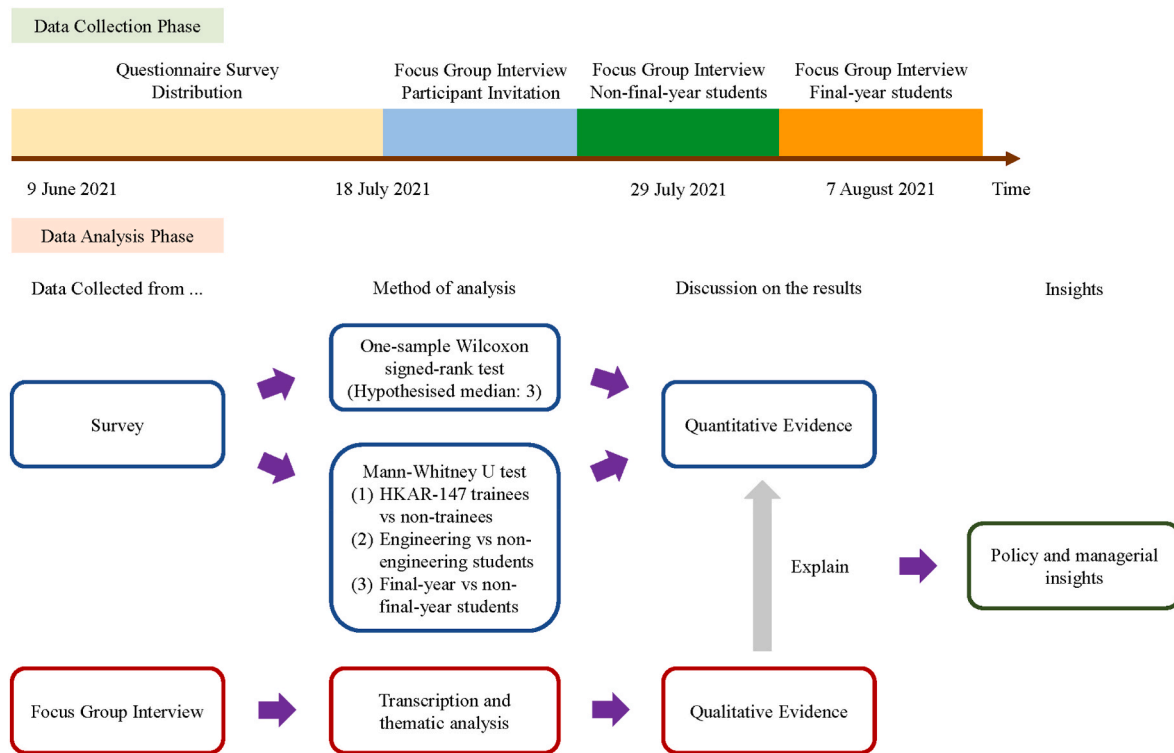


Fig. 2. The roadmap of this study.

Miani et al. (2021). The last section requires the participants to fill in several demographic information as stated in Table 1. After the design of the questionnaire, several industry aviation practitioners were consulted. All of them agreed with the items included in the survey. Each item is presented with a Five-point Likert scale ('1' implies strongly disagree while '5' implies strongly agree) except for questions related to perceived possible future areas of career/studies, which are presented with options 'Yes' and 'No'.

### 3.2.2. Data collection

All participants of the self-administered online survey are students (including final-year students in the academic year 2020/21) studying aviation-related tertiary education programmes in Hong Kong. 'Tertiary education programme in Hong Kong' refers to undergraduate (i.e., Associate Degree, Higher Diploma, Bachelor's Degree) and taught postgraduate (i.e., Master's Degree) programmes offered by institutions in Hong Kong. The survey is distributed through a non-random purposive sampling method. Invitation to the survey is sent to the participants via their programme-offering departments. Data were collected from June 9, 2021 to July 18, 2021. Participation in this survey is voluntary.

Table 1 reports the descriptive statistics of respondents. There were 101 valid responses. 87.1% ( $n = 88$ ) of our respondents are male, while female participants share 12.9% ( $n = 13$ ). The participants are aged between 18 and 25. Most respondents ( $n = 39$ , 38.6%) come from BEng (Hons) in Aviation Engineering of PolyU. Currently, four programmes in Hong Kong embedded the HKAR-147 approved aircraft maintenance training in the curriculum, including BEng (Hons) in Aviation Engineering (optional element) and BEng (Hons) in Air Transport Engineering (optional element) from PolyU, BEng (Hons) in Aircraft Engineering from THEi, and Higher Diploma in Aircraft Maintenance Engineering from HKIVE. Most respondents come from an engineering-related aviation programme ( $n = 91$ , 90.1%). Some aviation-related programmes in Hong Kong were included in the survey invitation, but no responses from their students were received (see Appendix A).

Per the small sample size and non-homogeneity of the respondents, non-parametric tests are used. The one-sample Wilcoxon signed-rank

test is adopted to evaluate whether the median is significantly different from the hypothesised median of '3' (neither agree nor disagree) (Harris and Hardin, 2013). Also, the Mann-Whitney  $U$  test is adopted to compare the difference between three different groups: (1) HKAR-147 training: Trainees versus non-trainees, (2) Programme nature: Engineering versus non-engineering, (3) Year of study: Final-year students versus non-final-year students in the academic year 2020/21 (Harris and Hardin, 2013). We did not assume normal distribution in both the one-sample Wilcoxon signed-rank test and Mann-Whitney  $U$  test. Descriptive statistics and chi-square test results are provided for items on the perceived possible future area of career/studies. The statistical analyses were conducted with IBM SPSS Statistics 26.

### 3.3. Focus group interview

To understand their concerns in-depth, survey respondents are invited to participate in focus group interviews. Six participants (Table 2) agreed to participate in the on-site focus group interviews. The focus group interviews were conducted on July 29, 2021 (for non-final-year students) and August 7, 2021 (for final-year students). Written informed consent was obtained before the interview. The participants were compensated with monetary rewards. The interview was conducted in Cantonese, voice-recorded and translated into English for analysis.

A thematic analysis was then applied to analyse the qualitative evidence. The analysis approach aims to establish common themes, patterns, and ideas in text-based data. Authors first undergo an overview to familiarise themselves with the interview transcript. Then, the interview transcript was coded manually with shorthand labels. After that, coded data were collated to generate several themes to highlight the key concerns of aviation students. Themes are then revised to ensure an accurate presentation of the data analysed. Eventually, the results of the analysis are placed in Section 4.1.

**Table 1**  
Respondents' characteristics of the survey (N = 101).

| Attributes   | Total sample (N = 101) |         |
|--|------------------------|---------|
|  | Freq.                  | Percent |
| Gender   |                        |         |
| Male   | 88                     | 87.1    |
| Female   | 13                     | 12.9    |
| Prefer not to say  | 0                      | 0       |
| Programme studying/graduating from   |                        |         |
| PolyU – BEng (Hons) in Aviation Engineering <sup>#</sup>   | 31                     | 30.7    |
| PolyU – BEng (Hons) in Aviation Engineering with optional HKAR-147 Training <sup>#&amp;</sup>      | 8                      | 7.9     |
| PolyU – BEng (Hons) in Air Transport Engineering <sup>#</sup>                                      | 15                     | 14.9    |
| PolyU – BEng (Hons) in Air Transport Engineering with optional HKAR-147 Training <sup>#&amp;</sup> | 6                      | 5.9     |
| PolyU – BSc (Hons) in Aviation Operations and Systems <sup>#</sup>                                 | 4                      | 4.0     |
| HKUST – BEng (Hons) in Aerospace Engineering <sup>#</sup>  | 3                      | 3.0     |
| HKUST – MSc in Aeronautical Engineering <sup>#</sup>   | 2                      | 2.0     |
| HKIVE – Higher Diploma in Aviation   | 4                      | 4.0     |
| PolyU HKCC – Higher Diploma in Aircraft Services Engineering <sup>#</sup>                          | 22                     | 21.8    |
| HKU SPACE – Higher Diploma in Airline and Airport Services   | 2                      | 2.0     |
| HKU SPACE – Higher Diploma in Aviation Studies   | 2                      | 2.0     |
| HKU SPACE – Higher Diploma in Aviation and Piloting  | 1                      | 1.0     |
| Other institutions – non-engineering related Bachelor's degree offered in part-time mode           | 1                      | 1.0     |
| Year of study  |                        |         |
| Associate Degree/Higher Diploma/Bachelor's Degree Year 1   | 23                     | 22.8    |
| Associate Degree/Higher Diploma/Bachelor's Degree Year 2   | 32                     | 31.7    |
| Bachelor's Degree Year 3 & Bachelor's Degree senior-year intake/Top-up Bachelor's Degree Year 1    | 17                     | 16.8    |
| Bachelor's Degree Year 4 & Bachelor's Degree senior-year intake/Top-up Bachelor's Degree Year 2    | 27                     | 26.7    |
| Master's Degree Year 1   | 2                      | 2.0     |
| Graduation status  |                        |         |
| Final-year students  | 47                     | 46.5    |
| Non-final-year students  | 54                     | 53.5    |

Notes – Freq.: Frequency, Percent: Percentage (%), PolyU: The Hong Kong Polytechnic University, HKUST: The Hong Kong University of Science and Technology, HKIVE: Hong Kong Institute of Vocational Education, PolyU HKCC: The Hong Kong Polytechnic University – Hong Kong Community College, HKU SPACE: The University of Hong Kong – School of Professional and Continuing Education, #: Engineering-related programme, &: HKAR-147 training.

## 4. Results and discussions

### 4.1. Thematic analysis

The qualitative evidence obtained through focus group interviews was used for thematic analysis and to support the discussions. Five themes were generated from the qualitative data collected from focus group interviews, including the uncertain outlook of the aviation industry's recovery, lack of industrial and international opportunities, the essentiality of non-technical skills, the competitiveness of recent graduates in the aviation job market, and class delivery mode under the pandemic.

#### 4.1.1. Uncertain outlook of the aviation industry's recovery

Under the pandemic, numerous changes in social and business travelling behaviours might affect the aviation industry's recovery. The post-pandemic 'new normal' is still full of uncertainty. As with the uncertain outlook of the aviation industry, aviation students might likely face 'career shock' or might face obstacles when seeking aviation-related careers. In the focus group interview, participants expressed uncertainties regarding the industry's recovery: "I am not sure about the exact time", "I think it is hard to predict, with the new strain of the virus", and "it will be hard to predict the trend since the methods (for business travel) has changed". A final-year participant and a non-final-year participant suggested the pandemic situation will highly vary the time of recovery: "the time will depend on the development of the pandemic situation", "as the pandemic subsides, the situation will begin to improve", but "there will be

**Table 2**  
Participants' characteristics of the focus group interview (N = 6).

| Group | Participant number | Gender | Programme of study                               | HKAR-147 training | Nature | Year of study  |
|-------|--------------------|--------|--|-------------------|--------|----------------|
| A     | 1                  | Male   | PolyU – BEng (Hons) in Aviation Engineering      | No                | ENG    | 3              |
|       |                    | Male   | HKU SPACE – Higher Diploma in Aviation Studies   | No                | N-ENG  | 1              |
|       | 2                  | Male   | PolyU – BEng (Hons) in Aviation Engineering      | Yes               | ENG    | 2              |
|       |                    | Male   | PolyU – BEng (Hons) in Air Transport Engineering | Yes               | ENG    | 2 <sup>#</sup> |
|       | 3                  | Male   | PolyU – BEng (Hons) in Air Transport Engineering | No                | ENG    | 2 <sup>#</sup> |
|       |                    | Male   | PolyU – BEng (Hons) in Aviation Engineering      | No                | ENG    | 4 <sup>#</sup> |
| B     | 4                  | Male   | PolyU – BEng (Hons) in Air Transport Engineering | No                | ENG    | 2 <sup>#</sup> |
|       |                    | Female | PolyU – BEng (Hons) in Air Transport Engineering | No                | ENG    | 4 <sup>#</sup> |
|       | 6                  | Male   | PolyU – BEng (Hons) in Aviation Engineering      | No                | ENG    | 4 <sup>#</sup> |

Notes – (N-)ENG: (Non-)Engineering, Year of study marked with #: Final-year student, PolyU: The Hong Kong Polytechnic University, HKU SPACE: The University of Hong Kong – School of Professional and Continuing Education.

some small ups-and-downs" and "will not happen in the near future". The border restrictions are the key measures that impede the recovery. Still, anti-pandemic policies are set up locally and vary across the globe: "Although border restrictions in the United States and Europe are being lifted, and the United Kingdom stated that vaccinated people can skip quarantine, the situation in Asia is different". Hong Kong adopts a relatively conservative approach to zero-COVID, while western countries are trying to recover their tourism and aviation despite the risk brought by COVID-19 contraction. However, globally, "the pandemic has changed everyone's travelling habits". The recovery in aviation is thus affected by the business practices in the 'new normal', as "some business trips might not be needed again". It is because "online meetings can already achieve the same results". As such, there is no need for business travel, resulting in "less demand (for air travel) from the business side". Regarding career opportunities, the situation is also fluctuating: "you can see from the news that there are layoffs, but at that same time, some graduates are able to find jobs within this industry". Nevertheless, the industry can hardly return "to the level before COVID-19". It will "take longer" before recovering from the recession, which made students unsure "whether I am (we are) still working in the same industry".

#### 4.1.2. Lack of industrial and international opportunities

While the recovery of the aviation industry is uncertain, students and recent graduates may better prepare themselves for the post-pandemic age. Of which, industrial and international opportunities are generally agreed upon by participants that can help students to acquire out-of-classroom knowledge and insights.

Students find their academic study focuses on delivering knowledge with a trimmed emphasis on practice: "a lot of the time it's just 'talk' and (we) never really tried to carry out (the task)", "it is common in Hong Kong to be more like 'talk' rather than doing the tasks". Particularly, engineering students value learning-by-doing: "the only way to learn is to do it". On-the-job training in a local aircraft maintenance, repair, and overhaul (MRO) organisations made students "learnt many new things during each visit" and reflected that "I believe I do not have enough skills". Students

believe that when they “experience more”, they “will have better insight” into the industry and “decide if the job is suitable” after graduation. Being interns related to the student’s major studies lets students “get to experience and understand it (this industry) sooner”. Students can be familiar with “work in this type of environment” and “will be beneficial to future career development”. For instance, shift work is inevitable in most operations-related positions, and students “might not be able to adapt to the work shift system”. Earlier exposure in the industry also provides students with “more tasks to do and more things to learn”, which helps them to “build up their network” in the industry for future career development. Good performers may also gain “a better impression” in the company. Short-term industrial visits also provide students opportunities to “see how work is done”, which supplements long-term internships. International opportunities such as outbound exchange and competitions can help students get to “know more people”. Students with international experience will not be “limiting themselves here (in Hong Kong)” and may consider obtaining “more internationally recognised” aircraft maintenance licenses from other national aviation authorities such as the European Union Aviation Safety Agency (EASA) or the Federal Aviation Administration (FAA).

However, the pandemic made these opportunities hard to be realised: “we used to have the opportunity to work in Government Flying Service (GFS) for practical work training, but it was cancelled due to the pandemic”, said an HKAR-147 trainee. Students also find it hard to attend international competitions in person to observe the performance of other teams: “I was supposed to travel to the US for my competition, but they were all cancelled”, which obstructed students from learning from their peers worldwide. International exchange opportunities are also considered an opportunity that requires support from the institutions, which students can hardly realise under the pandemic and impedes their learning opportunities. While cross-border activities are suspended, the “no gathering policy will limit the number of school activities” such as industrial talks and visits. Institutions “cannot afford the risk and decided to cancel these activities”: “there are many opportunities for year one students to have industrial visits, but most are cancelled due to the pandemic”. In which, a visit to Heliservices could only accommodate less than one-sixth of the cohort when compared to previous years, which hindered students’ industrial exposure.

#### 4.1.3. Essentiality of non-technical skills

Apart from hard-core technical knowledge and skills gained from academic subjects and practical training, non-technical skills such as interpersonal communication, teamwork, and leadership, are considered essential for job searching in the post-pandemic. Amongst the soft skills, most agreed communication skills are necessary and important, regardless of the job nature (engineering or non-engineering): “for people working in maintenance, many are rough around the edges, so communications skills are necessary”. Communication skills refer to the ability to “express your ideas clearly and precisely with no complication” and deliver one’s ideas to the audience with “clear, precise, and use suitable words”. As a result, others can “comprehend what you are talking about”, thus preventing accidents from occurring due to misunderstandings. Based on effective communication, teamwork is essential as “one person cannot do all the work alone” in the aviation industry. It further promotes an individual’s organisational management and leadership ability, which a participant claimed that his/her “current job requires this type of ability”. Leadership “incorporates communication” and students shall learn “to be persuasive”. “If you can work in an organised manner, you can work more efficiently”, said a non-engineering student participant that values management skills. Most importantly, another participant shared his peers’ experience in an aptitude test that “scored extremely low on questions about management”, which implies that training in soft skills may not be sufficient and shall be enhanced. These skills facilitate job hunting as “these are the qualities that human resources (personnel) want to see (would like you to have)”. Compared with various technical skills, students find soft skills are more transferrable to other fields. Technical

skills such as aircraft material, structure, and avionics might be useful in the aviation sector, but these skills “are completely useless outside the aviation industry” and “work in other sectors”. With the uncertainty mentioned in Section 4.1.1, students may wish to acquire more generic and transferrable competencies for wider occupational mobility to address their ‘career shock’ before and after the recovery.

#### 4.1.4. Competitiveness of recent graduates in the aviation job market

The pandemic caused numerous experienced aviation professionals to be laid off. While it is vague whether the ex-employees will re-join the industry after the pandemic, aviation students might inevitably face competition from some experienced hires: “I think there will be some competition, but after a few years might not come back (to the aviation industry)”. It is thus essential to maintain their competitiveness in the aviation job market. Under the pandemic, students believe that one of their absolute advantages is that their remuneration shall normally be less than the experienced: “I would not need as much salary (than the experienced)”, reducing the cost required. Being younger is another advantage; in the long-term, the young talent “can work for me for a longer period” from the employer’s perspective. However, it is also noteworthy that the company’s hiring strategy is also critical. “If they are having a shortfall of staff, they might prefer experienced workers. But if they are looking for new staff members, they will accept both newcomers and experienced workers”, said a non-final year student. An engineering student highlighted that “hands-on experiences are just as important as academic knowledge”, so “it will be impossible to compete” if the company needs urgent manpower. Also, training newcomers take time and resources. Compared with licensed workers, students believe that they cannot compete as training newcomers is “another type of investment” from the company. Overall, students believe that “there will be some competition”, but the intensity varies as the company’s hiring strategy and positions hired will be the critical influencing factors.

#### 4.1.5. Class delivery mode under the pandemic

With the prevailing social distancing measures, many institutions have adopted the online teaching mode in lieu of traditional face-to-face teaching to ensure uninterrupted delivery of course content. While most students have already adapted to this teaching mode under the ‘new normal’, students believe that the virtual mode will suffer from several limitations. For instance, during online classes, students found that they cannot “get immediate responses if you (they) have a question”, and the learning environment cannot foster an immersive learning atmosphere: “for learning at home, your attitude will change, and you will tend to slack off”. A participant mentioned that students “will actually feel that you (they) are doing something when sitting in a classroom environment”, regardless of what they are doing in the class. Students’ feedback from the interview reflected that they could hardly focus on learning during virtual classes. An HKAR-147 trainee also reported that their training nature could barely be facilitated with online teaching mode: “throughout the course, we have only seen a picture (of the wire stripper), and we only learn how to use it through the listed steps”. He/she reported that he/she “never actually touched the real one (the wire stripper)”, which he/she believes “will be quite a big problem (in the future)”, as hard-core maintenance engineering depends on craftsmanship and practices. In short, the training nature made the class hard to be replaced by virtual delivery mode. Thus, a non-final year student prefers face-to-face teaching as it “can provide a better learning environment”. Nonetheless, the online teaching mode still elicits positive impacts on aviation students learning to some degree. Students appreciated that some institutions require instructors to record all their lessons. Students find this arrangement facilitates their completion of assignments and revision before assessments as they can review them any time: “being able to watch the (lecture) playbacks is good”. While the new videotape initiative facilitates aviation students’ learning, the class delivery mode shall be selected with care according to the course nature, particularly on courses with hands-on components.

### 4.2. Perceived personal impediments

During the COVID-19 pandemic, aviation students might encounter personal barriers. Table 3 shows the descriptive statistics and the results of the one-sample Wilcoxon signed-rank test.

Except for PI1 and PI6, the items under perceived personal impediments have medians of ‘4’. These items resulted in medium effect sizes (Cohen, 1988). While the financial situation might not significantly hinder students’ ability to complete their current aviation-related

**Table 3**  
Descriptive statistics and results of one-sample Wilcoxon signed-rank test for the perceived personal impediments.

| Item   | Descriptive |          | Wilcoxon signed-rank test |        |        |        |
|--|-------------|----------|---------------------------|--------|--------|--------|
|  | $\bar{x}$   | $\sigma$ | Median                    | $z$    | $p$    | $d$    |
| PI1: I find it hard to complete the current aviation-related academic/training programme due to my current financial situation.  | 2.90        | 1.05     | 3.00                      | -1.172 | 0.241  | -0.117 |
| PI2: I believe scholarships funded by local Government/Institutions (e.g., the Hong Kong Aviation Scholarship) could relieve the financial burden in the current programme of study. | 3.90        | 1.03     | 4.00                      | 6.368  | <0.001 | 0.634  |
| PI3: I would consider an alternative career path while the industry recovers.  | 3.60        | 0.98     | 4.00                      | 5.521  | <0.001 | 0.549  |
| PI4: I would consider alternative studies while the industry recovers.   | 3.40        | 0.96     | 4.00                      | 4.172  | <0.001 | 0.415  |
| PI5: I believe I lack appropriate technical skills in respond to the future role and professional requirements.  | 3.60        | 0.92     | 4.00                      | 5.757  | <0.001 | 0.573  |
| PI6: I believe I lack appropriate non-technical skills in respond to the future role and professional requirements.  | 3.20        | 0.99     | 3.00                      | 1.728  | 0.084  | 0.172  |
| PI7: I would consider alternative career options after receiving advice from my mentors/parents/advisors.  | 3.70        | 0.81     | 4.00                      | 6.283  | <0.001 | 0.625  |
| PI8: I would consider alternative career options after receiving advice from my peers (e.g., classmates, friends).   | 3.60        | 0.88     | 4.00                      | 5.652  | <0.001 | 0.562  |

Notes –  $z$ : Standardised test statistic,  $p$ : Level of significance,  $d$ : Cohen’s  $d$  effect size.

programme ( $p = 0.241$ ), they agreed (72.28%,  $p < 0.001$ ) that providing scholarships from the Government/Institutions could relieve the financial burden. Compared to non-technical skills, more students perceived they lacked appropriate technical skills (67.53%) rather than non-technical skills (40.59%) in response to the future role and professional requirements. Yet, in the interview, all agreed that non-technical skills are also essential to their future career in aviation. However, non-technical skills could be acquired through social learning during daily life. Engineering and HKAR-147 students faced a lack of practical training due to the switch to virtual classes, resulting in a lack of technical skills. Lastly, students generally agreed that they would consider pursuing alternative careers when others advise them. Of which, advice from mentors/parents/advisors cause a stronger motivation ( $d = 0.625$ ) than classmates/friends ( $d = 0.562$ ).

Only PI6 tested significantly different between different years of study through the Mann-Whitney  $U$  test ( $U = 819.0$ ,  $z = -3.199$ ,  $p = 0.001$ ,  $d = -0.318$ ). The mean rank of final-year students (60.57) is higher than that of non-final-year students (42.67), implying that final-year students perceive themselves as lacking more non-technical skills than the non-final-year students. While non-final-year students still have several years to develop such skills, final-year students might find it hard to acquire and master such skills within such a short period. A final-year focus group interview participant highlighted the essentiality of non-technical skills during job interviews and workplaces. He/she also believes non-final-year students have more time for development. Other final-year participants believe non-technical skills are transferrable to different industries. They also believe that being an undergraduate is a precious opportunity for acquiring non-technical skills. Yet, they reported there is room for improvement in such training.

In short, Hong Kong aviation students’ financial status and lack of non-technical skills are not significant impediments. While non-technical skills are essential, mostly final-year students are afraid they lack such skills. Meanwhile, their technical skills, personal desires, and advice from significant others in pursuing alternative career paths and studies hindered their career in aviation.

### 4.3. Perceived external impediments

External impediments, such as the industry’s competitiveness, recovery, and local anti-COVID-19 policies, are also other key factors in students’ studies and future aviation career decisions. Table 4 shows the descriptive statistics and the results of the one-sample Wilcoxon signed-rank test.

Except for EI1, all statements in external impediments received a median of ‘4’, indicating the external impediments to Hong Kong aviation students’ career paths are immense. While the median of EI2 and EI3 is lower than the study in Australia (Miani et al., 2021), results demonstrated that Hong Kong aviation students fiercely agreed that they find it hard to compete with experienced hires as vacancies are reduced in the aviation industry. However, it also depends on the companies’ hiring strategies, as agreed by the interview participants. While the experienced hires have the advantage of “immediate availability” to pick up tasks, the participants believe that newcomers could be nurtured gradually in the long-term, resulting in a more sustainable workforce with lower expenditure on remuneration. Moreover, some experienced aviation professionals might also depart from the aviation industry after being laid off. Therefore, despite the ever-changing pandemic situation and anti-pandemic policies, Hong Kong aviation students believe they can compete with the existing aviation professionals.

The results of the Mann-Whitney  $U$  test demonstrated significant differences between engineering and non-engineering students for EI2 ( $U = 290.5$ ,  $z = -1.978$ ,  $p = 0.048$ ,  $d = -0.197$ ) and EI5 ( $U = 279.0$ ,  $z = -2.345$ ,  $p = 0.020$ ,  $d = -0.233$ ). The mean rank of EI2 revealed that engineering students (52.81) find it harder to compete with experienced aviation professionals than non-engineering students (34.55). This is reflected in the focus group interview as most engineering students



**Table 4**  
Descriptive statistics and results of one-sample Wilcoxon signed-rank test for the perceived external impediments.

| Item  | Descriptive |          | Wilcoxon signed-rank test |       |        |       |
|---|-------------|----------|---------------------------|-------|--------|-------|
|   | $\bar{x}$   | $\sigma$ | Median                    | $z$   | $p$    | $d$   |
| EI1: I find it hard to complete the current aviation-related academic/training program due to the restrictions imposed by the Government.   | 3.10        | 1.11     | 3.00                      | 0.736 | 0.462  | 0.073 |
| EI2: I find it hard to compete with experienced aviation professionals in the current time of having an oversupply of aviation professionals.   | 3.70        | 1.03     | 4.00                      | 5.283 | <0.001 | 0.526 |
| EI3: I perceive there would be less availability of vacancies in the aviation industry in the coming two to three years.  | 3.90        | 0.92     | 4.00                      | 6.884 | <0.001 | 0.685 |
| EI4: I believe the current policies/solutions (e.g., social distance measures and regulations, availability of vaccine type) to address the COVID-19 pandemic could not turn the pandemic under control.  | 3.60        | 1.07     | 4.00                      | 4.703 | <0.001 | 0.468 |
| EI5: I believe there is a recession in the global economic conditions reducing the air transport demand within two to three years.  | 3.80        | 0.80     | 4.00                      | 7.100 | <0.001 | 0.706 |
| EI6: I believe the air transport demand would return to the pre-pandemic level after three years.   | 3.60        | 0.92     | 4.00                      | 5.405 | <0.001 | 0.538 |
| EI7: I believe the current relaxation in safety regulations and airworthiness requirements (e.g., carrying cargo in the cabin, flexibility in licensing continuity, shortening the length of quarantine for flight crews) could enhance the robustness of the air transport industry under the COVID-19 pandemic. | 3.90        | 0.72     | 4.00                      | 7.553 | <0.001 | 0.752 |

Notes –  $z$ : Standardised test statistic,  $d$ : Cohen’s  $d$  effect size.

expressed that hands-on experience is essential for workplace success – as important as academic knowledge, as the trade skills gained in the aircraft maintenance organisation setting could demonstrate their workmanship and engineering competency. Comparatively, non-engineering students might focus on knowledge-based tasks, resulting in a difference between students from different areas of study. The mean rank of EI5 for engineering students (52.93) is also higher than that of non-engineering students (33.40), which can be explained by the

difference in perception of the ‘aviation industry’. While engineering students focus on the technical side, non-engineering students might have a broader perception. During the pandemic, passenger travel demand plunged. In contrast, the air cargo demand remains at a high level to transport anti-pandemic goods, such as the surging need for face masks, hand sanitisers, and even vaccines, across the globe. Therefore, the overall growth of the industry also needs to take the performance of air cargo into account.

While the Government’s anti-pandemic restrictions do not cause significant impediments, the HKAR-147 participants reported that their specialised training was conducted through online teaching in the past year. This has drastically impeded learning effectiveness. Also, their practicum opportunities in maintenance organisations were suspended. Nonetheless, the online synchronised teaching mode was also widely utilised in Hong Kong, resulting in no significant differences between the HKAR-147 trainees and non-trainees. Some even vote for the online mode as classes will be recorded, allowing for follow-up reviews, resulting in the median of ‘3’ for EI1, with no significant difference observed between any comparisons.

In short, most analysed groups perceived similarly regard to external impediments. The two exceptions are: engineering students find it harder to compete with experienced aviation professionals and believe there will be a recession in the coming 2–3 years compared to non-engineering students.

#### 4.4. Perceived importance of emerging knowledge & skill sets

With the permanent change in the industry, the competitiveness for positions in the aviation industry is intense. It is essential for a candidate to be equipped with up-to-date skills. In addition, the persistent technological advancement in aviation also changed the skill sets required. For instance, emerging technologies and areas such as UAS and air logistics management have been emphasised in the past decade. The public also emphasises several soft skills like customer service management, organisational management, and leadership (Lee et al., 2018). Meanwhile, traditional skills such as aircraft engineering and

**Table 5**  
Descriptive statistics and results of one-sample Wilcoxon signed-rank test for the perceived importance of emerging knowledge & skill sets.

| Item  | Descriptive |          | Wilcoxon signed-rank test |       |        |       |
|---|-------------|----------|---------------------------|-------|--------|-------|
|   | $\bar{x}$   | $\sigma$ | Median                    | $z$   | $p$    | $d$   |
| BKS1: Emerging intelligent technologies with aeronautical/aviation elements (e.g., Unmanned Aerial Systems) | 3.70        | 0.66     | 4.00                      | 7.494 | <0.001 | 0.746 |
| BKS2: Aircraft engineering and maintenance  | 4.20        | 0.74     | 4.00                      | 8.205 | <0.001 | 0.816 |
| BKS3: Airline administration & operations management  | 4.00        | 0.71     | 4.00                      | 8.000 | <0.001 | 0.796 |
| BKS4: Air logistics & cargo management (e.g., Dangerous Goods Regulations)                                  | 4.00        | 0.65     | 4.00                      | 8.333 | <0.001 | 0.829 |
| BKS5: Customer service management   | 3.60        | 0.79     | 4.00                      | 5.722 | <0.001 | 0.569 |
| BKS6: Pilot ground theory   | 3.90        | 1.05     | 4.00                      | 6.199 | <0.001 | 0.617 |
| BKS7: Organisational management & leadership  | 4.00        | 0.79     | 4.00                      | 7.773 | <0.001 | 0.773 |

Notes –  $z$ : Standardised test statistic,  $d$ : Cohen’s  $d$  effect size.

maintenance, administration and operations management remain critical. Survey participants rated the perceived importance of said areas, and Table 5 shows the descriptive statistics and the results of the one-sample Wilcoxon signed-rank test.

All items have a median of ‘4’. The Cohen’s *d* effect sizes are at least medium (*d* = 0.5), with even higher effect size on ‘aircraft engineering and maintenance’ (*d* = 0.816), ‘air logistics & cargo management’ (*d* = 0.829), and ‘airline administration & operations management’ (*d* = 0.796). This aligns with the industry structure in Hong Kong, in which the trading and logistics sectors contributed to Hong Kong’s GDP greatly (Census and Statistics Department, 2021). In addition, several MRO organisations in Hong Kong are recognised by customers globally. These strong track records might boost the students’ desire to acquire such skill sets. For airline administration and operations management, a focus group interview participant mentioned that knowing the operational flow of the industry is advantageous, as they could harness the relevant knowledge and apply them in their future career. Interestingly, customer service management only attains a medium effect size. An engineering focus group interview participant explained that the said skill might not be quite useful in the industry but instead might be practical for non-engineering aviation students.

The results of the Mann-Whitney *U* test demonstrated no significant difference between each of the studied groups, showing students’ desire to retain occupational mobility. In the focus group interview, the participants generally agreed that aviation is a professional discipline. However, an individual’s occupational mobility is inversely proportional to their level of specialism in certain areas (Dlouhy and Biemann, 2018). Therefore, aviation students might perceive their occupational mobility as lower than others. Uncertainties, such as COVID-19, caused the global economic downturn and dramatically deteriorated the aviation industry with repetitive layoffs. Occupational changes, as defined as the stage of transition and vocational behaviours preparation, e.g., acquisition of new skills, knowledge, training, and education (Feldman and Ng, 2007), shall be necessary. Eventually, they wished to acquire more skill sets that could benefit them when working in other disciplines in aviation.

In the focus group interview, the participants are invited to vote for a skill set from Table 5 that they believe is the most important to them. Two votes were received for ‘Airline administration & operations management’ and ‘Organisational management & leadership’, which previous helped them transition from learners to practitioners. Participants believe familiarising themselves with the industry’s operations could facilitate future job responsibilities. Administrative duties are

inevitable, and most tasks in the aviation industry are operation oriented. Therefore, students believe that understanding the operations of an airline could advance and smoothen the transition when they enter the industry. They also believe that the latter (management and leadership) are transferrable skills. An HKAR-147 trainee voted for ‘pilot ground theory’ as he believes the integration of flight operations and maintenance could advance his understanding of the operations of an aircraft. It evidenced the desire for students to broaden their horizons to acquire knowledge of different sub-disciplines.

#### 4.5. Post-graduation development options

To evaluate their preference for alternative career/study options, participants were asked whether they would consider 1) alternative career options not directly related to the respondents’ major in the aviation industry, 2) alternative career options in non-aviation-related positions, 3) studies after graduation in an aviation-related taught programme, 4) studies after graduation in a non-aviation-related taught programme, and 5) studies after graduation in a research programme.

The chi-square test is conducted for each prospective area of career and study. The results in Table 6 demonstrated no statistically significant associations between each variable and each category of participants, consistent with Miani et al. (2021). Nonetheless, overwhelmingly, aviation students in Hong Kong across all groups (at least 64.3%, benchmarked with HKAR-147 trainees) intend to work in the aviation industry but will still consider pursuing a non-directly related career. Comparatively, more student pilots and non-first-year cohorts in Australia tend not to consider alternative roles in the aviation industry. In the focus group interview, a non-final-year HKAR-147 trainee mentioned that the training provided a fast track for them to become an aircraft maintenance engineer. A final-year HKAR-147 trainee also deemed aircraft maintenance personnel is considered as a ‘professional’, which fosters them to work in the aircraft maintenance industry. Nevertheless, due to multiple uncertainties like new virus variants, vaccines’ effectiveness, travel restrictions, etc., engineering students would generally consider and are open to other engineering jobs if the job nature is interesting. In addition, the remuneration from alternative careers could also provide financial support to explore their career options.

The case for further studies in taught programmes also yielded similar results: most students still consider studying in an aviation-related programme in Hong Kong. This is different from the Australian students studied by Miani et al. (2021), where Australian students

**Table 6**  
Percentage distribution and chi-square test results of post-graduate development options.

| Category                 | n  | Alternative career                      |      |   |      | Studies                                 |      |   |      | Research                                |      |
|--------------------------|----|---|------|---|------|---|------|---|------|---|------|
|                          |    | Aviation                                |      | Non-aviation                            |      | Aviation                                |      | Non-aviation                            |      | Yes                                     | No   |
|                          |    | Yes                                     | No   | Yes                                     | No   | Yes                                     | No   | Yes                                     | No   |   |      |
| <b>HKAR-147 Training</b> |    |   |      |   |      |   |      |   |      |   |      |
| Trainees                 | 14 | 64.3                                    | 35.7 | 57.1                                    | 42.9 | 64.3                                    | 35.7 | 42.9                                    | 57.1 | 35.7                                    | 64.3 |
| Non-Trainees             | 87 | 82.8                                    | 17.2 | 66.7                                    | 33.3 | 69.0                                    | 31.0 | 54.0                                    | 46.0 | 47.1                                    | 52.9 |
|                          |    | $\chi^2(1) = 2.591$<br><i>p</i> = 0.107 |      | $\chi^2(1) = 0.483$<br><i>p</i> = 0.487 |      | $\chi^2(1) = 0.122$<br><i>p</i> = 0.727 |      | $\chi^2(1) = 0.603$<br><i>p</i> = 0.437 |      | $\chi^2(1) = 0.633$<br><i>p</i> = 0.426 |      |
| <b>Area of study</b>     |    |   |      |   |      |   |      |   |      |   |      |
| Engineering              | 91 | 79.1                                    | 20.9 | 64.8                                    | 35.2 | 67.0                                    | 33.0 | 51.6                                    | 48.4 | 46.2                                    | 53.8 |
| Non-engineering          | 10 | 90.0                                    | 10.0 | 70.0                                    | 30.0 | 80.0                                    | 20.0 | 60.0                                    | 40.0 | 40.0                                    | 60.0 |
|                          |    | $\chi^2(1) = 0.671$<br><i>p</i> = 0.413 |      | $\chi^2(1) = 0.106$<br><i>p</i> = .745  |      | $\chi^2(1) = 0.700$<br><i>p</i> = 0.403 |      | $\chi^2(1) = 0.252$<br><i>p</i> = 0.616 |      | $\chi^2(1) = 0.138$<br><i>p</i> = 0.711 |      |
| <b>Year of study</b>     |    |   |      |   |      |   |      |   |      |   |      |
| Final-year               | 47 | 74.5                                    | 25.5 | 70.2                                    | 29.8 | 72.3                                    | 27.7 | 57.4                                    | 42.6 | 48.9                                    | 51.1 |
| Non-final-year           | 54 | 85.2                                    | 14.8 | 61.1                                    | 38.9 | 64.8                                    | 35.2 | 48.1                                    | 51.9 | 42.6                                    | 57.4 |
|                          |    | $\chi^2(1) = 1.817$<br><i>p</i> = 0.178 |      | $\chi^2(1) = 0.919$<br><i>p</i> = 0.338 |      | $\chi^2(1) = 0.658$<br><i>p</i> = 0.417 |      | $\chi^2(1) = 0.871$<br><i>p</i> = 0.351 |      | $\chi^2(1) = 0.408$<br><i>p</i> = 0.523 |      |

Notes – Figures except the chi-square statistic and *p*-value are expressed in percentage (%).

overwhelmingly will refrain from further studying in an aviation-related taught programme in the future, which could be a result of the time of the survey. In the focus group interview, students mentioned that travel restriction is only one of the numerous factors that could affect the future recovery and growth of the aviation industry. They also believe the travel demand would only surge right after the alleviation of travel restrictions instead of growing sustainably. However, the non-final-year students perceived that there are still years until graduation. They believed that the demand and job openings would return when they graduate. A first-year student also claimed that his determination and passion for aviation are hard to be affected by the industry’s demand.

To sum up, the results demonstrated the demand of the industry might incur a career shock on aviation students in Hong Kong, while their determination in aviation is a key factor for them to retain themselves to work in the aviation industry.

4.6. Perceived importance of other learning supports

In Section 4.3, the importance of diversified emerging knowledge is presented. Providing adequate knowledge is essential for education institutions, at the same time, various educational support shall also be offered to their students. While technical skills could be delivered through coursework, non-technical skills training could be provided through other learning activities. Additionally, institutions could incorporate opportunities for industrial and international exposure, minor studies, free electives, career support, and advising services to shape their students for better preparation. Table 7 shows the descriptive statistics and results of the one-sample Wilcoxon signed-rank test for these possible learning supports that universities can potentially

**Table 7**  
Descriptive statistics and results of one-sample Wilcoxon signed-rank test for the perceived importance of learning supports the universities can potentially provide.

| Item  | Descriptive |          | Wilcoxon signed-rank test |       |        |       |
|---|-------------|----------|---------------------------|-------|--------|-------|
|   | $\bar{x}$   | $\sigma$ | Median                    | $z$   | $p$    | $d$   |
| SU1: Adequate training programs and technical skills for other roles in the aviation industry   | 4.10        | 0.90     | 4.00                      | 7.400 | <0.001 | 0.736 |
| SU2: Development of non-technical skills which are beneficial to my future career in the aviation industry (e.g., leadership, communication, language proficiency, critical thinking, crisis management training) | 3.90        | 0.89     | 4.00                      | 6.805 | <0.001 | 0.677 |
| SU3: Opportunities for industrial & international exposure (e.g., internship, international exchange studies)   | 4.20        | 0.76     | 4.00                      | 8.115 | <0.001 | 0.807 |
| SU4: Multidisciplinary knowledge (e.g., minor studies, free electives)  | 3.70        | 0.83     | 4.00                      | 6.329 | <0.001 | 0.630 |
| SU5: Adequate preparation for the contemporary challenges & educational support (e.g., academic advising, counselling, career talk, industrial seminars)  | 3.80        | 0.78     | 4.00                      | 7.007 | <0.001 | 0.697 |

Notes –  $z$ : Standardised test statistic,  $d$ : Cohen’s  $d$  effect size.

provide.

All supports received a median of ‘4’ (Table 7), while SU1 and SU3 attained a higher Cohen’s  $d$  effect size at 0.736 and 0.807, respectively. Meanwhile, the Mann-Whitney  $U$  test revealed no statistically significant differences between any groups, implying all participants perceived similarly on these possible supports. In the focus group interview, students are invited to vote for their perceived most important support. All participants overwhelmingly agreed that the opportunity for industrial and international exposure is the learning support they wish to receive the most. Some explained that the industrial opportunities could offer them an opportunity to build a network with senior industrial practitioners. Particularly, during the internships, networking lunches helps students to learn and gain insights from the industry’s senior management. Besides, internships and industrial visits offer opportunities for familiarisation with the working environment and responsibilities. Therefore, industrial exposure provided an early opportunity for students to realise whether they are suitable for the tasks and the working environment. Additionally, students believe companies are more willing to offer future opportunities, such as return offers, for those who performed well and are experienced. Apart from industrial exposure, international exposure could also diversify students’ insights. Focus group interview participants believe gaining in-depth international exposure, such as through outbound exchange studies, is hard to realise without the support of the universities. Non-technical skills such as cross-cultural communication could also be learnt from international exchanges. Another participant undergoing HKAR-147 training also claimed that international exposure allows students to have a more global outlook instead of limiting themselves to Hong Kong. The aircraft maintenance licenses issued by other states, such as the FAR-66 or the EASA Part 66, could also be pursued in lieu, and the applicability of the license might be raised.

In short, most students considered industrial and international exposure the most critical support the universities could provide. The universities should emphasise securing future opportunities for industrial and international exposure for their students – which would lead to a mutually beneficial solution. The students could expose themselves to the industry earlier to gain experience and realise their suitability, while the universities could gain reputations from the students. More resources, such as manpower and financial support, could be allocated to search for these opportunities for students.

5. Policy & managerial insights

The results generally reflected that Hong Kong aviation students are ambitious to work in the aviation industry even under the COVID-19 pandemic, with the pandemic situation in Hong Kong continuing to fluctuate and the ever-changing anti-pandemic policies. They believed being experienced in the industry is not the absolute advantage, as the employers would consider a variety of factors, including the sustainability of the workforce in the long term. Nevertheless, this does not imply that students are not considering other job opportunities. Students overwhelmingly agreed that they are willing to pursue careers beyond their specialism in the aviation industry. Yet, the industry might also miss lots of young talents, particularly in the engineering sector, which would likely consider working as engineers outside the aviation industry. Thus, the policymakers, the senior industry management, and the universities shall make pinpointed policies and provide sufficient supports to retain this group of future aviation professionals, which eventually could sustain Hong Kong’s success in aviation.

5.1. Comparison of post-pandemic aviation training recovery between Hong Kong and Singapore

While the current study analysed the impacts of COVID-19 on aviation training and students’ career prospects in Hong Kong, it is noteworthy that Singapore, which shares a similar geographical size and

location in the Asia Pacific region with Hong Kong, can serve as a location for comparison of the situation that students face due to the pandemic. In particular, both Hong Kong and Singapore do not have domestic flights during the pandemic. [Sobie \(2022\)](#) also commented that the persistent zero-COVID policy in Hong Kong made Singapore Asia's leading aviation hub. Therefore, a comparison between Hong Kong and Singapore will be drawn on the post-pandemic aviation training recovery.

In Singapore, other than academic institutions that provide formal academic programmes on aerospace engineering, the Civil Aviation Authority of Singapore (CAAS) also established the Singapore Aviation Academy (SAA) to offer specialised aviation training programmes. Several flying colleges in Singapore can offer flight training opportunities. Due to the pandemic, commercial aviation activities were greatly trimmed. However, Singapore owns a military force, and numerous general aviation activities remain active within the territory of Singapore. Student pilots can then switch their careers, at least temporarily, with the air force or with general aviation firms. Regarding post-pandemic recovery, Singapore is taking an active approach by providing new training programmes ([CAAS, 2022](#); [ICAO, 2022](#)). ICAO and Singapore will jointly deliver a global training programme on aviation recovery and resilience, targeted at the Director-General of Civil Aviation (DGCA) of the ICAO contracting states. The training course equips them with novel skills and competencies for overcoming the foresighted post-pandemic challenges while searching for new opportunities during the pandemic. They also signed a three-year extension to the Developing Countries Training Programme (DCTP), which offers an opportunity to enhance the capability of aviation professionals from less developed countries.

Meanwhile, the case in Hong Kong is not the same as in Singapore. In Hong Kong, there has no military force and limited general aviation activities. Commercial aviation remains the core of Hong Kong's aviation industry, which mainly supports the tourism, trading, and logistics industries. Therefore, Singapore's policy might not be appropriate for direct adoption in Hong Kong. However, Hong Kong is in a strategic position in the Asia Pacific with the support of the Greater Bay Area (GBA). The newly signed JMMCA, as mentioned in [Section 1](#), offers new horizons for aircraft maintenance personnel to work in other GBA cities or cities in China. This policy also aligns with the need for international exposure, which outbound experience to other cities might facilitate the career development of Hong Kong aviation students. Given the diversity of the market, Singapore can offer non-commercial aviation opportunities to their aviation students/trainees during the pandemic. However, Hong Kong might find it hard to achieve the same. Therefore, resources can be aligned to provide more continuous development opportunities and international exposure under the JMMCA.

## 5.2. Insights and recommendations

As illustrated in [Section 2.1](#), [Sullivan and Al Ariss \(2021\)](#) highlighted that the forced pursuance of alternative career pathways might lead to potential anxiety. Hence, aviation students' career shock shall be well-addressed by evidence-based policy design. Meanwhile, many 'new normal' occurred during the pandemic, with numerous reformations and challenges faced by the industry, e.g., online meetings replaced face-to-face business travels. The skills required for a pandemic-resilient workforce shall also cope with the reformations and challenges. The Government and the aviation industry shall also note the time lag effect of possible low enrolment in aviation courses. Particularly, specialised training such as aircraft maintenance license training takes at least 2–3 years. Learning from the case in the United States, the number of new aircraft maintenance certificates issued in 2020 dropped by 30% in 2020 than that in 2019 ([Aviation Technician Education Council, 2021](#); [Silk, 2022](#)). [Fig. 1](#) illustrates the minimum timespan that knowledge and practical training have to be completed for licensed aircraft maintenance engineers. A temporary shortage of aviation professionals might

hardly be refilled shortly. Such alarm raised concerns about the capacity and the position of aviation hubs in the Asia Pacific when facing the post-pandemic surge, particularly for the MRO industry ([CAPA Centre for Aviation, 2021](#)). Given the above analysis on impediments, curriculum tuning, and potential supports, the following insights and recommendations could be considered for implementation.

1. **Direct financial support:** While most students have no financial impediments to their study under the pandemic, students overwhelmingly agreed that the provision of scholarships could help relieve their financial burden. This direct financial support could also serve as an encouragement to their studies, which aids students in focusing on their study and enhance their willingness to work in the aviation industry during and after the pandemic. [Sobieralski \(2020\)](#) suggested that Governmental support shall pinpoint those in need, such as the less-skills workforce, to encourage continuous education. Thus, these scholarships or support funds could be provided by the Government, the institutions, or even the industry's companies to recognise young talent's effort and devotement. Indeed, the Hong Kong Government launched an anti-epidemic fund – employment support scheme in 2022 ([Secretary for Labour & Welfare, 2022](#)). However, the scope can further be extended to students, which strengthen their confidence in working in the aviation industry in the future. To ensure scholarship recipients will work in the aviation industry in the future, suitable conditions and constraints of the scholarship could be considered, such as the minimum years of post-graduate work in the industry. Eventually, these supports can retain sufficient trained aviation professionals, such as aircraft maintenance engineers, to cope with the post-pandemic demand surge and minimise the disruption of air travel recovery due to labour shortage ([Westbrook, 2022](#)).
2. **Advisory supports from significant others:** Students shall be provided advisory support from mentors, advisors or parents as the results reveal that it is likely to be more effective than peer support. Therefore, a proper mentorship programme co-organised by the universities and the industry could be considered. Senior management and experienced aviation professionals could act as mentors under mentorship programmes to advise the juniors on their potential development pathways. Past research, such as [Ilkhanizadeh and Karatepe \(2017\)](#), also suggested that mentorships, career plans, and succession strategies can be offered by companies in the industries which the current study aligns with. Eventually, students' confidence and understanding of the industry would be reinforced.
3. **Teaching pedagogy and mode of class:** Indeed, distance learning in aviation was not new and was established decades ago ([Raisinghani et al., 2005](#)). However, the teaching and learning quality shall not be ignored when considering students' benefits. While anti-pandemic policies shall be observed, the universities shall also take the programme's nature into account. Several hands-on experiences, such as sheet metal manufacturing, are hard to be replaced with online appreciation tasks through watching videos, particularly for the engineering and HKAR-147 students. [EASA \(2020\)](#) also identified that backlog in training capacity shall be aware as there could be potential skills and knowledge degradation during low-traffic scenarios. Therefore, the universities shall well-consider the nature of training and maintain essential technical skills training face-to-face to maximise the teaching effectiveness. [Kearns \(2016\)](#) found that the quality of virtual aviation courses is way too diversified: some courses directly transformed conventional classroom delivery to online mode without thoroughly considering the difference between the two environments. Also, [Ng \(2022\)](#) concluded that students criticise online teaching pedagogy based on its effectiveness. While virtual teaching might lack the components for essential practices, students find the lesson recordings from this teaching mode useful as they can review them any time after the lesson. This arrangement under the virtual teaching mode can

instead facilitate students' timely revision for completing assignments and before quizzes, tests, and examinations. This suggests that the videotaping policy is highly feasible and, as such, should be continued as a standard practice to facilitate students' learning post-pandemic. With Sun et al. (2021)'s conclusion, combining videotaping policy with blended learning might further expedite students' learning. Eventually, the pandemic can elicit some positive impacts to facilitate aviation students' learning.

4. **Targeted training under limited resources:** It is noteworthy that final-year students face the urgent and essential need to acquire sufficient non-technical skills before they enter the labour market. Our findings align with Sun et al. (2021) that aviation students and recent graduates shall be equipped with soft skills as they are essential for eliciting pandemic-resilient aviation. Per the urgency of acquiring non-technical skills such as leadership, communication, language proficiency, critical thinking, and crisis management for final-year students, the universities could first align their resources to provide such training to final-year students. Non-final-year students could be trained for non-technical skills in embedded coursework that highly demand communication, leadership, and critical thinking.
5. **Local context-based curriculum tuning:** While most emerging areas in aviation shall broaden students' horizons and provide them with occupational mobility, several key skill sets shall be pinpointed and prioritised to suit the local industry demand. While Miani et al. (2021) reported the skill sets that align with the Australian aviation industry, differences were observed in Hong Kong's context in terms of the effect size. Such results are likely caused by the difference in industry structure as Hong Kong further demand maintenance-oriented personnel and operational knowledge. Hong Kong students' preference showed that they emphasise 'airline administration & operations management', 'air logistics & cargo management', 'aircraft engineering and maintenance', and 'Organisational management & leadership'. Meanwhile, the transferability of skill sets shall also be well-considered when tuning the curriculum to fit the local context.
6. **Other learning experiences:** Students' academic and social life was impacted by the pandemic, especially outbound activities and social gatherings were restricted (Aristovnik et al., 2020). The universities shall also put an emphasis on the provision of international and industrial exposure. Industrial exposure offers students an early opportunity to discover their future working environment and first-hand understand the latest industry development. Precisely, the universities could actively seek networking opportunities and placement partnerships for students so that they could secure industrial exposure. International exposure, such as inter-institutional academic exchanges, also provides students with a global outlook to facilitate the internationalisation of the university and students.

## 6. Concluding remarks

Under COVID-19, aviation students' and graduates' advancement in their future careers are inevitably hindered. They might have to consider alternative career paths temporarily or permanently. However, Hong Kong's success in tourism, trading, and logistics industries demands support from aviation talents heavily. The industry would definitely miss lots of young professionals that could foster its sustainable development. Therefore, the core contribution of this study is to make policy recommendations to higher education institutions on 'how' and 'what' to support these students with limited resources under the pandemic. We revealed the impediments to post-pandemic career development and career prospects for Hong Kong tertiary aviation students via both broad surveys and focus group interviews.

Aviation students in Hong Kong generally consider technical skills, personal desire, and advice from significant others in pursuing alternative career paths and studies as the main factors behind the hindrance

to their career development. Final-year students perceive they lack non-technical skills, more so than non-final-year students. Meanwhile, engineering students find it harder to compete with experienced hires and perceived the industry would further suffer from recession. In the future, universities could further align resources on strengthening student's knowledge and experience in 'airline administration & operations management', 'air logistics & cargo management', 'aircraft engineering and maintenance', and 'Organisational management & leadership', which are perceived by students as essential skill sets to cope with the ever-changing industry. It is noteworthy that students might be open to other jobs of similar nature. Yet, the professionalism of the job nature and the determination to work in the aviation industry is the key factors for students to continue their journey in aviation. Lastly, universities shall strengthen their student's opportunities for industrial and international exposure, such as internships and international exchange studies. The universities shall emphasise and align their resources in supporting internships and international exchange studies to enhance students' learning experiences.

Nonetheless, this study focuses on the Hong Kong context, where specialised training-embedded academic programmes are offered. However, as the academic programme curriculum and the industry's structure varies with countries, it is likely that the results are cultural-specific. Therefore, future work could focus on extending the results to multiple cultural contexts while retaining several cultural-specific elements to pinpoint the needs of individual countries. Depending on the data analysis methodology and the local student population, the sample size shall be further raised through other data collection methods that may facilitate the provision of more sounding insights. Apart from that, the current study can also be extended as a longitudinal study to compare the difference between responses collected in different stages of the pandemic, as well as to observe the corresponding changes and dynamics. It is also noteworthy that the follow-up explanations model is used. In the future, a fully qualitative analysis could be carried out to identify students' concerns in career development. Remarkably, this study can serve as a solid ground for further investigation of the effect of the newly signed JMMCA within the GBA. Combined with the impacts of the pandemic, insights can be drawn into the career prospects of aviation students with the support of novel policies. All these future works facilitate the proposal of evidence-based recommendations for local aviation students to expand their career development and future perspectives in the GBA.

## Author statement

**Cho Yin Yiu:** Conceptualisation, methodology, data curation, formal analysis, validation, investigation, writing – original draft, writing – review & editing; **Kam K.H. Ng:** Conceptualisation, validation, resources, writing – review & editing, supervision, project administration, funding acquisition; **Simon C.M. Yu:** Writing – review & editing, supervision; **Chun Wah Yu:** Investigation, writing – review & editing.

## Declarations of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

## Acknowledgment

The research is supported by Department of Aeronautical and Aviation Engineering, The Hong Kong Polytechnic University, Hong Kong SAR. Our gratitude is also extended to the Research Committee of

the Department of Aeronautical and Aviation Engineering, The Hong Kong Polytechnic University for support of the project (8CQM, ZVS9, RLP A). Cho Yin Yiu is a recipient of the Hong Kong PhD Fellowship of the Research Grants Council, The Government of the Hong Kong Special

Administrative Region (Reference number: PF21-62058). This study has been granted human ethics approval from the PolyU Institutional Review Board of The Hong Kong Polytechnic University (IRB Reference Number: HSEARS20210218003).

## Appendix A. Institutions/Programmes that no responses were received

**Table 8**  
Programmes that are excluded from analysis due to nil responses

| Institution | Programme   |
|-------------|---|
| PolyU       | BBA (Hons) in Aviation Management and Logistics                       |
| PolyU       | MSc in Mechanical Engineering (Aeronautical Engineering) <sup>#</sup> |
| PolyU       | MSc in Mechanical Engineering (Aviation) <sup>#</sup>                 |
| THEi        | BEng (Hons) in Aircraft Engineering <sup>#&amp;</sup>                 |
| HKIVE       | Higher Diploma in Aircraft Maintenance Engineering <sup>#&amp;</sup>  |
| HKIVE       | Higher Diploma in Airport Operations Management                       |
| UOWCHK      | ASc in Airport Operations and Aviation Logistics                      |
| UOWCHK      | ASc in Aviation and Pilot Studies                                     |
| UOWCHK      | BAv (Hons) in Operations and Management                               |

Notes – Invitations were sent but no responses were received. PolyU: The Hong Kong Polytechnic University, THEi: Technological and Higher Education Institute of Hong Kong, HKIVE: Hong Kong Institute of Vocational Education, UOWCHK: University of Wollongong College Hong Kong, <sup>#</sup>: Engineering-related programme, <sup>&</sup>: HKAR-147 training.

## References

- Akkermans, J., Richardson, J., Kraimer, M.L., 2020. The Covid-19 crisis as a career shock: implications for careers and vocational behavior. *J. Vocat. Behav.* 119, 103434.
- Akkermans, J., Seibert, S.E., Mol, S.T., 2018. Tales of the unexpected: integrating career shocks in the contemporary careers literature. *SA J. Ind. Psychol.* 44, 2018)DO - 10.4102/sajip.v44i0.1503.
- Albers, S., Rundshagen, V., 2020. 'European airlines' strategic responses to the COVID-19 pandemic (January-May, 2020). *J. Air Transport. Manag.* 87, 101863.
- Andaregie, A., Astatkie, T., 2021. COVID-19 impact on jobs at private schools and colleges in Northern Ethiopia. *Int. J. Educ. Dev.* 85, 102456.
- Aničić, K.P., Bušelić, V., 2021. Importance of generic skills of ICT graduates—employers, teaching staff, and students perspective. *IEEE Trans. Educ.* 64 (3), 245–252.
- Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., Umek, L., 2020. Impacts of the COVID-19 pandemic on life of higher education students: a global perspective. *Sustainability* 12 (20), 8438.
- Aviation Technician Education Council, 2021. 2021 Pipeline Report.
- Belser, C.T., Prescod, D.J., 2021. Conceptualizing COVID-19-related career concerns using bioecological systems: implications for career practice. *Career Dev. Q.* 69 (4), 355–370.
- CAAS, 2022. ICAO and Singapore to Jointly Deliver Global Programme on Aviation Recovery and Resilience.
- Canet-Vélez, O., Botigué, T., Lavedán Santamaría, A., Masot, O., Cemeli, T., Roca, J., 2021. The perception of training and professional development according to nursing students as health workers during COVID-19: a qualitative study. *Nurse Educ. Pract.* 53, 103072.
- CAPA Centre for Aviation, 2021. Post-pandemic Surge Could Pressure Asia-Pacific MRO Capacity.
- Census and Statistics Department, 2021. The Four Key Industries and Other Selected Industries.
- Cohen, J., 1988. *Statistical Power Analysis for the Behavioral Sciences*. Academic press.
- Creswell, J.W., Plano Clark, V.L., 2007. *Designing and Conducting Mixed Methods Research*. SAGE Publications, Thousand Oaks, Calif. Thousand Oaks, Calif.
- Czerny, A.I., Fu, X., Lei, Z., Oum, T.H., 2021. Post pandemic aviation market recovery: experience and lessons from China. *J. Air Transport. Manag.* 90, 101971.
- Dlouhy, K., Biemann, T., 2018. Path dependence in occupational careers: understanding occupational mobility development throughout individuals' careers. *J. Vocat. Behav.* 104, 86–97.
- Dube, K., Nhamo, G., Chikodzi, D., 2021. COVID-19 pandemic and prospects for recovery of the global aviation industry. *J. Air Transport. Manag.* 92, 102022.
- EASA, 2020. Review of Aviation Safety Issues Arising from the COVID-19 Pandemic.
- Feldman, D.C., Ng, T.W.H., 2007. Careers: mobility, embeddedness, and success. *J. Manag.* 33 (3), 350–377.
- Fraher, A.L., Gabriel, Y., 2014. Dreaming of flying when grounded: occupational identity and occupational fantasies of furloughed airline pilots. *J. Manag. Stud.* 51 (6), 926–951.
- Fullingim, J.F., 2011. The marketability of higher education aviation graduates as perceived by regional airline pilots. *Collegiate Aviation Rev.* 29 (1), 28–44.
- Gómez, J., Tayebi, A., Delgado, C., 2022. Factors that influence career choice in engineering students in Spain: a gender perspective. *IEEE Trans. Educ.* 65 (1), 81–92.
- Harris, T., Hardin, J.W., 2013. Exact Wilcoxon signed-rank and Wilcoxon Mann–Whitney Ranksum tests. *STATA J.* 13 (2), 337–343.
- Henderson, I.L., 2022. Aviation safety regulations for unmanned aircraft operations: perspectives from users. *Transport Pol.* 125, 192–206.
- Hogan, O., Charles, M.B., Kortt, M.A., 2021. Business education in Australia: COVID-19 and beyond. *J. High Educ. Pol. Manag.* 43 (6), 559–575.
- IATA, 2017. The Importance of Air Transport to Hong Kong (SAR), China.
- IATA, 2020. Recovery Delayed as International Travel Remains Locked Down.
- ICAO, 2022. New Training Agreement between ICAO and Singapore.
- Ilkhanizadeh, S., Karatepe, O.M., 2017. An examination of the consequences of corporate social responsibility in the airline industry: work engagement, career satisfaction, and voice behavior. *J. Air Transport. Manag.* 59, 8–17.
- Jung, H.S., Jung, Y.S., Yoon, H.H., 2021. COVID-19: the effects of job insecurity on the job engagement and turnover intent of deluxe hotel employees and the moderating role of generational characteristics. *Int. J. Hospit. Manag.* 92, 102703.
- Kearns, S.K., 2016. *E-Learning in Aviation*. Routledge.
- Lamb, T.L., Winter, S.R., Rice, S., Ruskin, K.J., Vaughn, A., 2020. Factors that predict passengers willingness to fly during and after the COVID-19 pandemic. *J. Air Transport. Manag.* 89, 101897.
- Lee, C.K.M., Ng, K.K.H., Chan, H.K., Choy, K.L., Tai, W.C., Choi, L.S., 2018. A multi-group analysis of social media engagement and loyalty constructs between full-service and low-cost carriers in Hong Kong. *J. Air Transport. Manag.* 73, 46–57.
- Lee, D., 2020. Cathay Dragon's 35-year Run Comes to an End as Coronavirus Claims One More Victim. *South China Morning Post*, Hong Kong.
- Lee, D., Choy, G., 2021. Nearly Two-Thirds of Hong Kong Airlines Workers Are Laid off or Take Pay Cuts'. *South China Morning Post*, Hong Kong.
- Lee, D., Magramo, K., 2020. Cathay Axes Record 5,300 Hong Kong Jobs and Closes Regional Airline in HK\$2.2 Billion Survival Plan. *South China Morning Post*, Hong Kong.
- Miani, P., Kille, T., Lee, S.-Y., Zhang, Y., Bates, P.R., 2021. The impact of the COVID-19 pandemic on current tertiary aviation education and future careers: students' perspective. *J. Air Transport. Manag.* 94, 102081.
- Ng, D.T.K., 2022. Online aviation learning experience during the COVID-19 pandemic in Hong Kong and Mainland China. *Br. J. Educ. Technol.* 53 (3), 443–474.
- Raisinghani, M., Chowdhury, M., Colquitt, C., Reyes, P.M., Bonakdar, N., Ray, J., Robles, J., 2005. Distance education in the business aviation industry: issues and opportunities. *Int. J. Dist. Educ. Technol.* 3 (1), 20–43.
- Rothengatter, W., Zhang, J., Hayashi, Y., Nosach, A., Wang, K., Oum, T.H., 2021. Pandemic waves and the time after Covid-19 – consequences for the transport sector. *Transport Pol.* 110, 225–237.
- Secretary for Labour & Welfare, 2022. Employment Support Scheme Set.
- Silk, R., 2022. Aircraft Mechanic Shortage Could Hamper Airline Operations', *Travel Weekly*.
- Sobie, B., 2022. Commentary: Hong Kong's Zero-COVID Policy an Opportunity for Singapore to Become Asia's Leading International Air Hub. *Channel News Asia*.
- Sobieralski, J.B., 2020. COVID-19 and airline employment: insights from historical uncertainty shocks to the industry. *Transp. Res. Interdiscip. Perspect.* 5, 100123.
- Suau-Sanchez, P., Voltes-Dorta, A., Cugueró-Escofet, N., 2020. An early assessment of the impact of COVID-19 on air transport: just another crisis or the end of aviation as we know it? *J. Transport Geogr.* 86, 102749.

- Sullivan, S.E., Al Ariss, A., 2021. Making sense of different perspectives on career transitions: a review and agenda for future research. *Hum. Resour. Manag. Rev.* 31 (1), 100727.
- Sun, X., Wandelt, S., Zhang, A., 2020. How did COVID-19 impact air transportation? A first peek through the lens of complex networks. *J. Air Transport. Manag.* 89, 101928.
- Sun, X., Wandelt, S., Zhang, A., 2021. Technological and educational challenges towards pandemic-resilient aviation. *Transport Pol.* 114, 104–115.
- Tisdall, L., Zhang, Y., 2020. Preparing for ‘COVID-27’: lessons in management focus – an Australian general aviation perspective. *J. Air Transport. Manag.* 89, 101922.
- Tisdall, L., Zhang, Y., Zhang, A., 2021. COVID-19 impacts on general aviation – comparative experiences, governmental responses and policy imperatives. *Transport Pol.* 110, 273–280.
- Usanmaz, O., 2011. Training of the maintenance personnel to prevent failures in aircraft systems. *Eng. Fail. Anal.* 18 (7), 1683–1688.
- Weissbach, D., Tebbe, K., 2016. Drones in sight: rapid growth through M&A’s in a soaring new industry. *Strat. Dir.* 32 (6), 37–39.
- Westbrook, L., 2022. Travel Disruption to Spill into First Quarter of 2023, Head of Global Airline Association Warns amid Labour Shortage and Rising Demand’, *South China Morning Post*. Doha.
- Wright, G.G., Herbert, L., Hilaire, B., Campbell, L.O., 2021. Impact of COVID-19 on employment: exploring the perspectives of job loss and mental health of individuals from minimal-resource communities. *Career Dev. Q.* 69 (4), 299–312.
- Yadav, D.K., 2010. Licensing and recognition of the aircraft maintenance engineers – a comparative study. *J. Air Transport. Manag.* 16 (5), 272–278.
- Yiu, C.Y., Ng, K.K.H., Lee, C.-H., Chow, C.T., Chan, T.C., Li, K.C., Wong, K.Y., 2021a. A digital twin-based platform towards intelligent automation with virtual counterparts of flight and air traffic control operations. *Appl. Sci.* 11 (22), 10923.
- Yiu, C.Y., Ng, K.K.H., Li, Q., 2021b. The air transport industry after the COVID-19: a structural equation modelling-based empirical study considering vaccines’ popularity and pandemic-associated risk. In: *The 24th ATRS World Conference*, Sydney, Australia (Online), Hong Kong, Hong Kong (Offline).
- Yiu, C.Y., Ng, K.K.H., Li, X., Zhang, X., Li, Q., Lam, H.S., Chong, M.H., 2022. Towards safe and collaborative aerodrome operations: assessing shared situational awareness for adverse weather detection with EEG-enabled Bayesian neural networks. *Adv. Eng. Inf.* 53, 101698.
- Zenker, S., Kock, F., 2020. The coronavirus pandemic – a critical discussion of a tourism research agenda. *Tourism Manag.* 81, 104164.
- Zhang, Y., Zhang, A., Wang, J., 2020. Exploring the roles of high-speed train, air and coach services in the spread of COVID-19 in China. *Transport Pol.* 94, 34–42.
- Zhu, C., Wu, J., Liu, M., Wang, L., Li, D., Kouvelas, A., 2021. Recovery preparedness of global air transport influenced by COVID-19 pandemic: policy intervention analysis. *Transport Pol.* 106, 54–63.