

RGC Ref. No.:

UGC/FDS14/B02/20

(please insert ref. above)

**RESEARCH GRANTS COUNCIL
COMPETITIVE RESEARCH FUNDING SCHEMES FOR
THE LOCAL SELF-FINANCING DEGREE SECTOR**

FACULTY DEVELOPMENT SCHEME (FDS)

Completion Report

(for completed projects only)

Submission Deadlines: 1. Auditor's report with unspent balance, if any: within **six** months of the approved project completion date.
2. Completion report: within **12** months of the approved project completion date.

Part A: The Project and Investigator(s)

1. Project Title

The Effects of Global Aviation Network Data Analytic Approach on Strategic Network

Development and Traffic Forecasting

2. Investigator(s) and Academic Department(s) / Unit(s) Involved

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	Dr. WONG Collin Wai Hung, Associate Professor	Department of Supply Chain and Information Management, The Hang Seng University of Hong Kong
Co-Investigator	Dr. CHEUNG Tommy Kin Yin, Senior Lecturer	Department of Aviation, Swinburne University of Technology
Co-Investigator	Prof. ZHANG Anming, Professor	Sauder School of Business University of British Columbia

3. Project Duration

	Original	Revised	Date of RGC / Institution Approval <i>(must be quoted)</i>
Project Start Date	2021.01.01		
Project Completion Date	2022.12.31	2023.06.30	2022.08.11 (RGC)
Duration <i>(in month)</i>	24	30	2022.08.11 (RGC)

Deadline for Submission of Completion Report	2023.12.31	2024.06.30	2022.08.11 (RGC)
--	------------	------------	------------------

- 4.4 Please attach photo(s) of acknowledgement of RGC-funded facilities / equipment.
N/A

Part B: The Final Report

5. Project Objectives

5.1 Objectives as per original application

1. To identify metrics to objectively evaluate route selection. These metrics may cover traffic growth and volume, existing airline networks, allied networks, multi-airport regions, and connectivity potential.
2. To support airlines and airports' strategic route development by proposing a data analytic approach so as to identify new destinations based on the global air network
3. To propose a systematic ranking method to determine which potential new routes should be established.
4. To develop a core-auxiliary network model for long- and short-term forecasting of traffic demands.
5. To simulate multiple and/or simultaneous route changes and investigate how these changes influence travel flows between geographic regions.

5.2 Revised objectives

Date of approval from the RGC: _____

Reasons for the change: _____

- 1.
- 2.
3.

5.3 Realisation of the objectives

(Maximum 1 page; please state how and to what extent the project objectives have been achieved; give reasons for under-achievements and outline attempts to overcome problems, if any)

First of all, we developed A Global Airport Connectivity Index (GACI) is proposed, combining degree, closeness and eigenvector topological indicators and two new volumetric indicators. The GACI was calculated for every airport, and the evolution of air transport networks across all the world regions were studied. It can also precisely define

the airport roles, such as super-hub, major, regional, local and minor airport, in the regional and global aviation network.

Next, a new data analytic approach is proposed to identify new and long-lasting routes and to assess connection quality from the global network perspective. It includes a comprehensive methodology for analysing the aviation network, evaluating potential route quality, deciding which routes warrant the selection, and estimating the long-and-short term traffic volume forecasts of the selected new routes. Seven attributes have been developed for route selection, covering growth, volume and connectivity-potential. We utilized the massive flight schedule data, together with the set of performance metrics and airport-class information to identify, rank, and evaluate the high-quality new routes. Our method assesses the impact of the increased/decreased connectivity to direct passenger flows and examines how this connectivity change can amplify and propagate the benefits/losses of passenger flows to subsequent connections. Our framework explored those unserved destinations and discovered many possible opportunities for airlines and airports. It also simulated the impact of new routes, by estimating the GACI changes and projected volumes. Given a pair of origin and destination airports, we made use of the core-auxiliary network model to determine the long-term and short-term predictions of traffic. Lastly, a list of promising new destinations with estimated traffic volumes is created.

5.4 Summary of objectives addressed to date

Objectives <i>(as per 5.1/5.2 above)</i>	Addressed <i>(please tick)</i>	Percentage Achieved <i>(please estimate)</i>
1. To identify metrics to objectively....	√	100%
2. To support airlines and airports' strategic route development....	√	100%
3. To propose a systematic ranking method....	√	100%
4. To develop a core-auxiliary network model....	√	100%
5. To simulate multiple and/or simultaneous route changes....	√	100%

6. Research Outcome

6.1 Major findings and research outcome

(Maximum 1 page; please make reference to Part C where necessary)

1. Paper: Assessment of hub airports' connectivity and Self-Connection Potentials. Transport Policy

This study utilizes the global flight schedules over a period of one week to identify and evaluate all possible connections, including online, interline and passenger self-connections and assess their feasibility and practicality in terms of total travel time between two cities, transit time, flying distances, connection types, airport accessibility, airline services, and origin/destination markets.

The aim is to develop a methodology to measure an airport's connectivity and self-connection potential for passengers, then apply it to the top 50 hub airports (ranked by frequencies) in the world, subsequently analyze the types of airports and airlines being suitable for self-connections and how to maximize the potential.

The framework developed in this research can help airlines and airports identify and optimize their connectivity potentials and develop strategic partnerships.

2. Paper: A connectivity-based methodology for new air route identification, Transportation Research Part A

It provides a new dimension of new route assessment – global connectivity-potential, which is measured by how well the new destination airport can attract other airports to make a quality connection.

A connectivity-based methodology with a detailed framework was proposed to identify new destinations based on this global connectivity-potential and to predict demand for the new destination. The framework exploits the geographical relationships between airports and combines the network route supply data to make decisions and assessments in identifying the potential new destinations.

We dissect the aviation network into a stable core and a fast-changing auxiliary component and make use of this core-auxiliary network model to forecast the long-term and short-term trends in passenger travel. The proposed framework is effective in providing a list of promising new destinations, which can significantly improve the competitive advantage of the airlines.

6.2 Potential for further development of the research and the proposed course of action

(Maximum half a page)

1. To study the further impact of multi-airport region on the interactions of airports within the region, the co-petition effects, corresponding government policies, ground transportation linkages.
2. To study the aviation network recovery and changes after the pandemic.

7. Layman's Summary

(Describe in layman's language the nature, significance and value of the research project, in no more than 200 words)

This project has developed a methodology to measure an airport's connectivity and self-connection potential. Of the 50 airports analyzed, the Chinese airports and European secondary airports have the largest unserved market potential. This study is timely and has demonstrated self-connection built on a strategic airline-airport partnership would create win-win outcome for all the stakeholders.

This project also dissects the relationship between new routes and existing air network connectivity. A spatial connectivity-based methodology was proposed to identify new destinations and predict demand for the new destination. Applying a set of performance metrics and airport-class, we identify, rank, and evaluate the high-quality new routes. The economic impact of route development is large. For airports, it provides specific estimation of forecast demands, to plan for facility and capacity expansion. For airlines, it provides a better understanding of the impacts of global aviation network changes due to competition or route changes. For local authorities in the multi-airport region, it provides ways to analyse the airports' competition effects and facilitate collaborative route planning. For governments, it provides detailed estimation of the benefits or impacts provided by new routes, which facilitates the negotiation of the air service agreements.

Part C: Research Output**8. Peer-Reviewed Journal Publication(s) Arising Directly From This Research Project**

(Please attach a copy of the publication and/or the letter of acceptance if not yet submitted in the previous progress report(s). All listed publications must acknowledge RGC's funding support by quoting the specific grant reference.)

The Latest Status of Publications				Author(s) (denote the corresponding author with an asterisk*)	Title and Journal / Book (with the volume, pages and other necessary publishing details specified)	Submitted to RGC (indicate the year ending of the relevant progress report)	Attached to this Report (Yes or No)	Acknowledged the Support of RGC (Yes or No)	Accessible from the Institutional Repository (Yes or No)
Year of Publication	Year of Acceptance (For paper accepted but not yet published)	Under Review	Under Preparation (optional)						
2022	2022			Tommy Cheung*, Collin WH. Wong, Zheng Lei	Assessment of hub airports' connectivity and Self-Connection Potentials. Transport Policy, 127, 250-259	No	Yes (Annex I)	Yes	Yes https://researchdb.hsu.edu.hk/view/publication/202200336
2023	2023			Collin WH Wong, T. K. Y.*, & Zhang, A.	A connectivity-based methodology for new air route identification. <i>Transportation Research Part A: Policy and Practice</i> , 173, 103715.	No	Yes (Annex II)	Yes	Yes https://researchdb.hsu.edu.hk/view/publication/202300224

9. Recognized International Conference(s) In Which Paper(s) Related To This Research Project Was / Were Delivered

(Please attach a copy of each conference abstract)

Month / Year / Place	Title	Conference Name	Submitted to RGC (indicate the year ending of the relevant progress report)	Attached to this Report (Yes or No)	Acknowledged the Support of RGC (Yes or No)	Accessible from the Institutional Repository (Yes or No)
Aug 2021, Australia	A Connectivity-Based Methodology for New Air Route Identification	The 24 th Air Transport Research Society World Conference	Yes	Yes (Annex III)	Yes	Yes

Aug 2021, Australia	Assessment of Hub Airports' Self Connection Potentials	The 24 th Air Transport Research Society World Conference	Yes	Yes (Annex IV)	Yes	Yes
Jul 2023, Japan	Examining the Impacts and Recovery of Global Aviation Connectivity and Traffics during Pandemic	The 26th Air Transport Research Society World Conference	No	Yes (Annex V)	No (Conference dates were beyond completion time)	Yes

10. Whether Research Experience And New Knowledge Has Been Transferred / Has Contributed To Teaching And Learning

(Please elaborate)

I have applied the concepts and knowledge of aviation network studies into undergraduate and graduate courses: including SCM3601 Transportation Planning: Policies, Methods and System, Airfreight Management in Global Supply Chain, SCM6003 Transport Logistics and Law, as well as BBA-Supply Chain Management Students Final Year projects.

Several Press Interviews have been conducted as follows: (Annex VI, VIII, VIII, IX)

1. Press interview by China Daily, 2021.11.26, Flying High Over The Bay
2. Press interview by HK01, 2022.01.21 , 防疫限制危及香港航空樞紐「世一」地位？
3. Press interview by HK01, 2022.01.31, Omicron拖累國際空運 「全民缺貨」下半年有望緩解
4. Press interview by HK01, 2022.03.14, 大灣區航空 | 香港機場「一地兩檢」，然後呢？

11. Student(s) Trained

(Please attach a copy of the title page of the thesis)

Annexes X and XI

Name	Degree Registered for	Date of Registration	Date of Thesis Submission / Graduation
██████████	Supply Chain Management	Sept 2021	25th May 2023
██████████	Supply Chain Management	Sept 2021	25th May 2023
██████████	Supply Chain Management	Sept 2021	25th May 2023

██████████ ██████	Supply Chain Management	Sept 2021	25th May 2023
██████████ ██████	Supply Chain Management	Sept 2017	25th May 2021
██████████ ██████	Supply Chain Management	Sept 2017	25th May 2021
██████████ ██████	Supply Chain Management	Sept 2017	25th May 2021
██████████ ██████	Supply Chain Management	Sept 2017	25th May 2021

12. Other Impact

(e.g. award of patents or prizes, collaboration with other research institutions, technology transfer, teaching enhancement, etc.)

13. Statistics on Research Outputs

	Peer-reviewed Journal Publications	Conference Papers	Scholarly Books, Monographs and Chapters	Patents Awarded	Other Research Outputs (please specify)	
No. of outputs arising directly from this research project	2	3			Type	No.

14. Public Access Of Completion Report

(Please specify the information, if any, that cannot be provided for public access and give the reasons.)

Information that Cannot Be Provided for Public Access	Reasons
Student Name List	Privacy of the students