RGC Ref. No.:
UGC/FDS14/B20/14
(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

Supply chain decarbonisation: good industry practices and development of carbon footprint toolkit

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

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	Dr. WONG Yin Cheung, Eugene / Assistant Professor	Department of Supply Chain and Information Management
Co-Investigator(s)	Dr. HO Chi Kuen, Danny / Assistant Professor	Department of Supply Chain and Information Management
	Dr. LAU Ying Kei, Henry / Associate Professor	Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong
	Prof. CHAN Tung Sun, Felix / Professor	Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University
	Ir. Dr. Paul Tsui / Chairman	Hongkong Association of Freight Forwarding and Logistics Ltd. (HAFFA)
	Ms. HO Linda / Chief Executive Officer	The Green Council
Others	Emma Zhou / Research Assistant	Department of Supply Chain and Information Management
	Rachel Yip / Research Assistant	Department of Supply Chain and Information Management

3. Project Duration

	Original	**Revised**	**Date of RGC / Institution Approval** *(must be quoted)*
Project Start Date	1 November 2014	N/A	N/A
Project Completion Date	31 October 2016	30 April 2017	24 October 2016
Duration *(in month)*	24 months	30 months	24 October 2016
Deadline for Submission of Completion Report	31 October 2017	30 April 2018	24 October 2016

Part B: The Final Report

5. Project Objectives

5.1 Objectives as per original application

1. *Develop novel techniques in and knowledge of carbon footprint methodology;*
2. *Increase awareness and knowledge of students regarding current carbon emission issues, supply chain decarbonisation, and carbon footprints;*
3. *Develop practical tools to assist companies to model, reduce, and monitor carbon emissions, to benefit the company institution and the industry;*
4. *Enhance and update the current faculty education materials on supply chain decarbonisation.*

5.2 Revised objectives

Date of approval from the RGC: N/A

Reasons for the change: N/A

1. N/A

2. N/A

3. N/A

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)

1. Objective: To develop novel techniques in and knowledge of carbon footprint methodology
   (1) After literature review, pilot companies' operations review, data collection, and statistical analysis, a carbon footprint methodology and a novel carbon-driven multi-criteria truckload utilisation optimisation model are developed. A journal paper is compiled and submitted to a journal. The techniques and knowledge developed will also be published in the guideline which is one of the deliverable of the project.
   (2) A carbon footprint calculation and reporting system is developed using Visual Basic Application (VBA) and the system is applied in three pilot companies of the project. The results and findings have been presented in a conference paper in APDSI conference and written in the submitted journal paper

2. Objective: To increase awareness and knowledge of students regarding current carbon emission issues, supply chain decarbonisation, and carbon footprints

(1) *Final Year Project:* Four Final Year Project student teams are formed. They participated and took part in the development of carbon footprint toolkit. Through the project implementation, they increased the awareness of supply chain decarbonisation and carbon footprint. They also acquired knowledge and skills in carbon reporting, verification and simulation tools development during the project implementation.
(2) *Pilot companies project implementation:* Three pilot companies, Crown Logistics, AOC Ltd., and Power Hub, have participated in the project. The carbon emission activities in the office, warehouse, and vehicles have been mapped. A carbon report has been developed with reference to ISO14064 standard. A tool has been developed for carbon reporting. Letters of appreciation from the three companies have been received.
(3) *Workshops:* Three workshops are successfully organised with a total of 7 speakers invited. Students in the final year project groups and other students who are interested in supply chain decarbonisation gained the knowledge of carbon footprint, carbon reporting, carbon verification, and carbon footprint simulation tools.
(4) *Seminars:* A panel session (The 20th Asia Pacific Decision Sciences Institute Conference – Panel Discussion on Environmental Footprint – Green Design) and a seminar (Seminar on Cost vs Sustainability in Transport and Logistics) have been organized to enhance students, academics, and industry practitioners. A total of 120 participants attended the two events.
(5) *Supply Chain Decarbonisation Guideline:* A book, with carbon reporting guideline, pilot companies and case studies, has been published. It has been disseminated in the Hong Kong Book Fair in 2017.
(6) *Website:* A project website and a hotline service have been developed with English, Traditional Chinese and Simplified Chinese pages.
(7) *Newsletters:* 5 college news on supply chain decarbonisation workshops, seminar on cost vs sustainability and conference special session on environmental footprint have been posted. Supply Chain Decarbonisation Website News: http://scd.hsmc.edu.hk/en/news.

3. Objective: To develop practical tools to assist companies to model, reduce, and monitor carbon emissions, to benefit the company institution and the industry
(1) *Carbon emission calculation model and carbon reporting toolkit: The* toolkit with carbon emission calculation and reporting features are developed using Microsoft Excel and VBA. The calculation methodology and the reporting result are built in the tools for companies to continuously input latest data and monitor the carbon emission level of their companies.
(2) *Book publication:* A reference guideline, including calculation and reporting methodology, illustrations of carbon emission reporting implementation in pilot companies, and case studies are published. It will be a useful tool and reference for the industry and students in the area of supply chain decarbonisation.

4. Objective: To enhance and update the current faculty education materials on supply chain decarbonisation
(1) Teaching materials and group assignments: supply chain decarbonisation and the calculation methodology of carbon emissions in logistics company are added in teaching materials. Selected questions about carbon emission intensity measurement are added in the examination. Students are guided to conduct project about optimising the supply chain with the consideration of carbon emission, production and shipping costs, mode of transportation and the provided budget.

5.4 Summary of objectives addressed to date

Objectives *(as per 5.1/5.2 above)*	**Addressed** *(please tick)*	**Percentage Achieved** *(please estimate)*
1. Develop novel techniques in and knowledge of carbon footprint methodology;	✓	100%
2. Increase awareness and knowledge of students regarding current carbon emission issues, supply chain decarbonisation, and carbon footprints;	✓	100%
3. Develop practical tools to assist companies to model, reduce, and monitor carbon emissions, to benefit the company institution and the industry	✓	100%
4. Enhance and update the current faculty education materials on supply chain decarbonisation	✓	100%

6. Research Outcome

6.1 Major findings and research outcome
(Maximum 1 page; please make reference to Part C where necessary)

Major findings and research outcome include:

- A carbon footprint methodology and a novel carbon-driven multi-criteria truckload utilisation optimisation model are developed;
- A carbon footprint calculation and reporting system is developed using Visual Basic Application (VBA) and the system is applied in three pilot companies of the project;
- The emission on the offices, warehouses and vehicle fleet of the three third-party logistics companies are mapped and evaluated. Some have a higher proportion on warehouses while some on the vehicle fleet.
- Results and findings have been presented in a conference paper in APDSI conference and submitted to a journal paper.
- Five case studies about the best practice on sustainability and carbon emission mitigation have been conducted. The companies in the case study include DHL, Airport Authority Hong Kong (AAHK), WalMart, Swire, and Maersk. The methodology of slow steaming in lower cost and reducing carbon emission in ship liner companies has been investigated, a paper about utility-based decision support model on slow steaming in ship liner operations has been compiled and published in a journal.
- Emission trading scheme of China on transport and logistics sector, supply chain carbon footprint on beverage product, sustainability performance data measurement, and Eurasia landbridge transportation development have been evaluated and published as conference papers in various overseas and local conferences.
- A book, including calculation and reporting methodology, carbon footprint guideline, illustrations of carbon emission reporting implementation in pilot companies, and case studies, are published.

6.2 Potential for further development of the research and the proposed course of action *(Maximum half a page)*

Potential for further development of research include:

- Mapping carbon footprint of companies along the supply chain, including ship liner companies, airline companies, freight forwarder, and distributors;
- Developing a product carbon footprint tool for mapping and evaluating the carbon emission of a product; and
- Evaluating the carbon emission trading scheme of various countries.

7. Layman's Summary

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

The need for decarbonisation is highlighted in the future development of the logistics and supply chain during the World Economic Forum. International Energy Agency has recently reported that the transportation sector is the second-largest carbon emitter worldwide. The HKSAR government has stated that carbon emission legislation is of high priority in the government policy. The Hong Kong Stock Exchange has adopted international sustainability reporting standards and raised the companies' obligation level on these standards. However, most logistics and transportation companies are still not fully complying with them and carbon emission measurements have not been implemented. There are practitioners who do not have the experience or knowledge to measure, audit, and report their carbon emission activities. It is necessary to develop a novel carbon footprint toolkit that integrates carbon calculating, carbon auditing, and carbon reporting to model, monitor and reduce carbon emissions in the companies. A book has been published, containing case studies, seminars and workshops information and the developed toolkit. The project benefits logistics and transportation companies with the developed toolkit to cope with the environmental protection needs and government policies. Students can learn the importance of supply chain decarbonisation and apply the acquired knowledge in their future career.

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)*						
2015	-	-	-	Wong, E.Y.C.*, Tai, A.H., Lau, H.Y.K., Ramand, M.	An utility-based decision support sustainability model in slow steaming maritime operations / Transportation Research Part E 78 (2015) 57-69	2015	Yes	Yes	Yes
2017	-	-	-	Wong, E., Ho, D., Zhou, E., Yip, R.	Supply Chain Decarbonisation – A carbon footprint toolkit for logistics and transportation	2018	Yes	Yes	Yes
2018	-	-	-	Wong, E.Y.C.*, Tai, A.H., Zhou, E.	Optimising truckload operations in third-party logistics: a carbon footprint perspective in volatile supply chain. Transportation Research Part D: Transport and Environment. 63(2018) pp. 649-661.	2018	Yes	Yes	Yes

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)*
2015	Truckload Utilization and Its Initiatives in Mitigating Carbon Emissions and Operation Cost in Third-Party Logistics	2015 APDSI Conference	2015	Yes	Yes	Yes
2015	Sustainability and data analytics in response to dynamic supply chain infrastructure	2015 APDSI Conference	2015	Yes	Yes	Yes
2016	Evaluating emission trading scheme of China on transport and logistics sector	The 16th COTA International Conference of Transportation Professionals (CICTP2016), 6-9 July, 2016.	2016	Yes	Yes	Yes
2016	Paradigm shift of multimodal transportation under the development of Euroasia landbridges	Conference on Logistics and Maritime Studies on One Belt One Road, 10-11 May 2016.	2016	Yes	Yes	Yes
2016	Supply chain carbon footprint in beverage and wine product	2016 International Conference on Business and Information – Winter Session (BAI 2016-Winter), 2-4 February, 2016.	2016	Yes	Yes	Yes

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

(1) Teaching materials and lectures in the module of Shipping and Transport Logistics
The supply chain decarbonisation and the calculation methodology of carbon emissions of a logistics company are added in the teaching materials of the module of Shipping and Transport Logistics (SCM4202) in the BBA in Supply Chain Management programme. Selected questions about carbon emission intensity measurement are also added in the examination.

(2) Group assignments in the module of Shipping and Transport Logistics
There are 14 groups of students conducting group project about supply chain decarbonisation in the module carried out on the Semester 1 of 2014/15, Semester 1 of

2015/16, Semester 2 of 2015/16 and Semester 1 of 2016/17. Each team is needed to repackage the existing products and services provided in a logistics, freight forwarding, or ship liner company. It is a study to optimize the supply chain with the consideration of carbon emission, production and shipping costs, mode of transportation and the provided budget. Table 1 shows the examples of the role and customers of student groups. A group assignment involved with the optimisation of selection on modes of transportation using Solver tools has been incorporated with the factor of carbon emission.

(3) Final Year Project
Four groups of final year project has been involved in the carrying out projects on supply chain carbon footprint mapping in organisation level and explored emission mitigation initiatives.

11. Student(s) Trained

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

Name	Degree Registered for	Date of Registration	Date of Thesis Submission / Graduation
(Names are removed on the public access version)	BBA-SCM	2011	5 May 2015 / 2015
-	BBA-SCM	2011	15 May 2015 / 2015
-	BBA-SCM	2011	15 May 2015 / 2015
-	BBA-SCM	2011	15 May 2015 / 2015
-	BBA-SCM	2012	15 May 2015 / 2015
-	BBA-SCM	2011	15 May 2015 / 2015
-	BBA-SCM	2013	15 May 2015 / 2015
-	BBA-SCM	2013	15 May 2015 / 2015
-	BBA-SCM	2013	15 May 2015 / 2015
-	BBA-SCM	2012	15 May 2016 / 2016
-	BBA-SCM	2012	15 May 2016 / 2016
-	BBA-SCM	2012	15 May 2016 / 2016
-	BBA-SCM	2012	15 May 2016 / 2016
-	BBA-SCM	2012	15 May 2016 / 2016

12. Other Impact

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

Other impacts:

- Collaboration with other research institutions: The development of carbon footprint toolkit has been collaborated with Carbon Care Asia and the seminars and workshops are collaborated with Green Council and Carbon Care Asia. Invitations to the workshops have been sent to Hongkong Association of Freight Forwarding and Logistics (HAFFA) and Supply Chain Security Association (SCSA) to benefit the industry practitioners. The journal and conference papers have been collaborated with Hong Kong Polytechnic University, The University of Hong Kong, Orient Overseas Container Line, and Turnkey Solutions.
- Teaching enhancement: The module of SCM4202 Shipping and Transport Logistics in BBA in Supply Chain Management programme has been enhanced with enriched content on supply chain decarbonisation. Assignments and group project have been included the carbon emission and footprint consideration to increase the awareness of students in this subject.

13. 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**
N/A	N/A

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

FACULTY DEVELOPMENT SCHEME (FDS)

Completion Report - Attachment
(for completed projects only)

RGC Ref. No.:	UGC/FDS14/B20/14
Principal Investigator:	Dr. WONG Yin Cheung, Eugene
Project Title:	Supply chain decarbonisation: good industry practices and development of carbon footprint toolkit

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 [or conference]	2 (2 published)	5	1^	-	-

^ A book titled *Supply Chain Decarbonisation Guideline,* mentioned at Point 5 of the second objective in Section 5.3.