RGC Ref. No.:
UGC/FDS14/E01/15
(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

Sustainable Development for Community Dial-a-ride Services: Driving more People without more Vehicles

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

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	Dr. MO Yiu-wing/ Assistant Professor	Department of Supply Chain and Information Management/ The Hang Seng University of Hong Kong
Co-Investigator(s)	Dr. MAK Ho-yin/ Associate Professor	Saïd Business School/ University of Oxford

3. Project Duration

	Original	Revised	Date of RGC / Institution Approval *(must be quoted)*
Project Start Date	1/1/2016	NA	NA
Project Completion Date	31/12/2017	NA	NA
Duration *(in month)*	24 months	NA	NA
Deadline for Submission of Completion Report	31/12/2018	NA	NA

Part B: The Final Report

5. Project Objectives

5.1 Objectives as per original application

1. *Identify the fundamental relationships between pricing structures and vehicle scheduling methods in sustaining dial-a-ride service operations for non-profit transportation organizations.*
2. *Derive a new decision model with multi-stakeholder considerations of dial-a-ride services.*
3. *Evaluate the proposed service option of a vehicle pooling arrangement for dial-a-ride services.*
4. *Develop fast solution methods to enhance scheduling effectiveness and efficiency.*
5. *Establish simulation experiments for evaluating the solution method.*
6. *Publish the research results for academics and practitioners in the community service sector.*
7. *Propose further research areas based on this study's findings*

5.2 Revised objectives

Date of approval from the RGC: NA

Reasons for the change: NA

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)

All the proposed objectives have been achieved through market study, meeting, survey computer programming etc. The results have been published in journal papers and presented in international conference.

Regarding objectives 1-3, the focus was to study the stakeholders' considerations when developing sustainable strategies for dial-a-ride (DAR) service operations for people with disabilities for non-profit transportation organisations. To understand the management considerations from operator's perspective, we organized regular meetings with a director and a manager in the collaborated organisation. After defining a proposed strategy of a ride sharing option, we conducted a survey to gather the users' opinions. Those inputs were useful for us to derive a decision model which incorporated multi-stakeholder considerations, and the idea was presented in the conferences such as the Seventh POMS-HK International Conference and the 96th Annual Meeting of the Transportation Research Board.

Objectives 4-7 aimed to evaluate the proposed strategy for implementation. A fast algorithm was designed to merge different orders into a shared route which satisfied different users' requirements. The algorithm was implemented in Java programming language. Based on the data collected from the collaborated organization, we analyzed different scenarios to evaluate the relationships among user tolerance of early pick-up and late drop-off times, price discounts, and vehicle utilization. The results were published in an international journal paper.

5.4 Summary of objectives addressed to date

Objectives *(as per 5.1/5.2 above)*	Addressed *(please tick)*	Percentage achieved *(please estimate)*
1. *Identify the fundamental relationships of shared dial-a-ride operations*	✓	100%
2. *Derive a new decision model*	✓	100%
3. *Evaluate the proposed service option*	✓	100%
4. *Develop fast solution methods*	✓	100%
5. *Establish simulation experiments*	✓	100%
6. Publish results for academics and Practitioners	✓	100%
7. Propose further research areas	✓	100%

6. Research Outcome

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

In this project, the major findings and research outcome are summarized into two areas: i) Service option for accessible transportation services; ii) Technology adoption for non-profit organisations.

i. Service option for accessible transportation services: In the decades of aging population, many accessible transportation organizations face challenges, due to limited social welfare expenditure, in serving people with travel inconvenience sustainably. These organizations are also expected to provide multiple types of paratransit services to satisfy different needs of people. Through an empirical study and an optimization model, we propose a new service option for the dial-a-ride (DAR) service which has the lowest vehicle utilization because of its operational characteristics. For the ridesharing option, passengers share a vehicle in exchange for a discounted travel rate, but they may need to tolerate a longer traveling time. This type of decision model incorporates multiple stakeholders' considerations such as tolerances of early pick-up and late drop-off times, discount rate, and availability of services, in addition to the operational issue of vehicle utilization. The result has been published in an international journal paper, entitled "Mass Customizing Paratransit Services with a Ridesharing Option" accepted for the publication in IEEE Transactions on Engineering Management.

ii. Technology adoption for non-profit organisations: For non-profit organisations, it is crucial to track outcomes on service offering and what they spend on. However, it poses

challenges for those non-profit organisations to adopt new technologies when there is a lack of an integrative system framework. Through the research study with a non-profit accessible transportation organization, we identify the importance of integrating several information technology systems such as enterprise resource planning (ERP) system, geographic information system (GIS), vehicle scheduling system, simulation system etc, for the design of a new service option. Apart from the challenges in technological complexity, we are able to handle the requirement of affordable cost by using open-source software and developing an integrative platform. The application and challenges of how to integrate those technologies are reported in the paper entitled "Integrative Technologies to Sustain Dial-a-ride Services" in the journal of Asia Pacific Journal of Advanced Business and Social Studies.

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

Through meeting with the collaborating organisation, the PI's research team gained a comprehensive understanding of their dial-a-ride operations, identified areas for operational improvement and proposed the further study. In this research, the team developed a simulation experiment with a scheduling algorithm to support the review of ridesharing option. During the investigation, the PI also supervised a group of students to work on a final-year project to evaluate another accessible transportation service, schedule route service. With the research experience and the collaborating effort, the PI has obtained an extended grant support to address new issues concerning the systems design of integrating multiple paratransit services.

7. Layman's Summary

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

In a time characterised by an ageing population and increasing global demand for social welfare expenditure, researchers are exhibiting renewed interest in decision modeling for analytics, which assists the government and non-profit organisations in effectively serving the community. This research aims at developing sustainable strategies for non-profit transportation organisations to provide dial-a-ride (DAR) services for people with disabilities through the optimisation of revenue and resource management. As an on-demand, door-to-door transport service that requires advanced booking, DAR's utilisation rate is usually low compared with the scheduled route services, and this operation characteristic creates a relatively high ratio of subsidy per person. To address this issue by optimising the resource management, we will study the service options of shared dial-a-ride (SDAR). Through the empirical study and optimisation models, we identify the relationships among discount rates, passenger tolerance of longer traveling times and vehicle utilisation rates for the new sustainable strategies. Such methods and results are useful for accessible transportation organisations to serve more people without the demand of additional vehicles.

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 correspond-ing 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)*	Acknowl-edged 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)*						
2016	--	--	--	Daniel Y. W. Mo*, Collin W. H. Wong, Tommy K.Y. Cheung.	"Integrative technologies to sustain dial-a-ride services", Asia Pacific Journal of Advanced Business and Social Studies, 2(2), 514-522, 2016.	2016	Yes	Yes	2016
2018	--	--	--	Daniel Y. Mo*, Yue Wang, Y.C.E. Lee, Mitchell M. Tseng	"Mass Customizing Paratransit Services with a Ridesharing Option", IEEE Transactions on Engineering Management	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)*
1/2016/ HK	Sustainable strategies of non-profit dial-a-ride operations	The Seventh POMS-HK International Conference	2016	Yes	Yes	Yes
1/2017/ USA	Shared dial-a-ride service more people with lower price	The 96th Annual Meeting of the Transportation Research Board	2017	Yes	Yes	Yes

12/ 2017/ SG	Design of Mass Customized Paratransit Services	2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)	2017	Yes	Yes	Yes

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

The research experience and knowledge transfer have been achieved through supervision of group of students on a final-year project as well as developing new teaching materials in a module of information technology in supply chain. A group of students were involved to propose recommendation of key performance indicators and areas for operational improvement. In addition, the use of geographic information system for vehicle routing problem has also been developed to enhance the module content with the latest technology.

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
NA	NA	NA	NA

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

This research project makes long-term impacts, apart from the publication in the form of journal paper, and these include: i) collaboration with research institution and industrial organization; ii) Technology transfer to the community service organization.

i) Collaboration with research institution and industrial organization: With the research grant support, the PI gained the opportunity to share the research topics and ideas with other research institution in conferences. This facilitated the joint research study and one of the research papers was published in the journal of IEEE Transactions on Engineering Management. Such joint research work not only contributed to the academic community but also supported the policy and operational review for the collaborated organization.

ii) Technology transfer to the community service organization: During this collaboration effort, the PI's research team delivered a software package that could identify the traveling times among a set of locations based on Google Maps to support the transportation organisation's scheduling of vehicles. A software guideline with follow-up meetings was provided for the

sake of technology transfer to the industry. Last but not least, students were also involved in part of research study in terms of conducting survey and proposing practical recommendations for enhancing accessible transportation systems.

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**
NA	NA

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/E01/15
Principal Investigator:	Dr. MO Yiu-wing
Project Title:	Sustainable Development for Community Dial-a-ride Services: Driving more People without more Vehicles

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	3	0	0	0