RGC Ref. No.:
UGC/FDS15/E01/18
(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

Ocular behaviour, construction hazard awareness and an AI chatbot

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

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	LI Rita Yi-man / Associate Professor / Director	Department of Economics and Finance/Sustainable Real Estate Research Center/ Hong Kong Shue Yan University
Co-Investigator(s)	CHAU Kwong-wing / Chair Professor / Director	Department of Real Estate and Construction/ Ronald Coase Centre for Property Rights Research, the University of Hong Kong
	HO Daniel Chi-wing / Professor	Faculty of Design and Environment, Technological and Higher Education Institute of Hong Kong
	LU Weisheng / Associate Professor / Associate Dean (Research) / Director	Department of Real Estate and Construction / Faculty of Architecture / iLab@HKUrbanLab, the University of Hong Kong
Others	N/A	N/A

3. Project Duration

	Original	Revised	Date of RGC / Institution Approval *(must be quoted)*
Project Start Date	01/01/2019	N/A	N/A
Project Completion Date	31/12/2020	30/06/2021	10/11/2020
Duration *(in month)*	24	30	10/11/2020
Deadline for Submission of Completion Report	31/12/2021	30/06/2022	10/11/2020

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

Part B: The Final Report

5. Project Objectives

5.1 Objectives as per original application

1. To study the impacts of all-day activities and physiological, physical and mental health conditions on perceptual decision making in construction hazard identification by examining ocular behaviour.

2. To compare the different factors that affect building, civil engineering and retrofit project workers when identifying hazards.

3. To construct a knowledge base for the chatbot that contains information relevant to enhancing safety awareness in building, civil engineering and retrofit projects.

4. To develop a chatbot that aims to enhance construction practitioners' safety awareness.

5.2 Revised objectives

Date of approval from the RGC: N/A

Reasons for the change: N/A

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)

This study built a chatbot knowledge base by sending a request to construction practitioners to fill out a list of questions and answers related to construction safety hazards. It also collected knowledge shared online and on social media to fulfil objective 3. Half of the research participants joined chatbot training, and all participated in the eye-tracking experiments. To study the impacts of all-day activities, physiological, physical and mental health conditions on perceptual decision making in construction hazard identification by examining ocular behaviour, research participants wore a wearable watch and filled out the SF-12V2 questionnaire. The results were compared between different groups according to building, civil engineering and retrofit (fulfilled objective 2), physiological, physical and mental health conditions (fulfilled objective 1), experiences etc. As the chatbot shares the construction safety knowledge, this study fulfilled objective 4.

5.4 Summary of objectives addressed to date

Objectives *(as per 5.1/5.2 above)*	**Addressed** *(please tick)*	**Percentage Achieved** *(please estimate)*
1. To study the impacts of all-day activities and physiological, physical and mental health conditions on perceptual decision making in construction hazard identification by examining ocular behaviour.	✓	100%
2. To compare the different factors that affect building, civil engineering and retrofit project workers when identifying hazards.	✓	100%
3. To construct a knowledge base for the chatbot that contains information relevant to enhancing safety awareness in building, civil engineering and retrofit projects.	✓	100%
4. To develop a chatbot that aims to enhance construction practitioners' safety awareness	✓	100%

6. Research Outcome

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

The participants' situational awareness relates to their mental and physical states. This study conducted a self-filled questionnaire (SF-12V2) analysis to test mental and general health status impacts on 76 research participants' hazard awareness, half of whom received chatbot safety training. This study showed no significant difference in psychological and mental test scores and no significant difference between building, civil engineering and retrofit groups of participants. The eye-tracking heat maps show that construction practitioners with rich site experience have a broader focus. Experienced on-site workers tended to look for other dangers besides the main dangerous points and showed more confidence in identifying hazards. The fixation of the experienced group was significantly higher. Novices had a narrow and cautious focus. This study also created chatbots that ask questions about the hazards of each photo, allowing the participants to answer the questions and inform participants regarding the danger in the picture. The results indicated that chatbot was more helpful in improving novice and workers with shallow site experiences' hazard awareness.

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

As this research mainly focused on construction safety knowledge-sharing research, a similar approach can be applied to other types of knowledge sharing. Social media data online in other areas could also be a future research direction. We have used a similar approach to compare French and English occupational safety and carbon neutrality knowledge sharing study and will try to apply that in other research areas.

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 studies the impact of chatbot, individuals' health and background on construction hazard awareness.

Academic significance
An efficient safety information flow and proactive hazard awareness knowledge sharing are essential to construction practitioners. To construct the chatbots' knowledge base, the collected online and social media construction safety data allow us to know more about the types of safety knowledge shared on different online platforms and fill the research void.

Practical significance
Although the business sector has already adopted the AI chatbot for customer service customer queries, the construction industry has yet to follow. This study provides an alternative knowledge sharing solution during a lockdown. Besides, the experience of using wearable technology was shared with the industry and raised health awareness.

Teaching significance

This research results, methods and findings were shared with research methodology students. As standard economic data cannot reveal what is noticed or considered, only what is selected, eye tracking lets us know how choices are made. Besides, retrofit is one primary duty in property management, and safety is one major concern. The Master students of Asset and Property Management students were invited to join the research, and their results were shared with them.

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)*						
2020	N/A	N/A	N/A	Chellappa, Vigneshkumar*; Salve, Urmi Ravindra; Li, Rita Yi Man and Liias, Roode [appendix 1]	A knowledge-based approach for enhancing fall prevention in the construction industry. Journal of Statistics and Management Systems	2019	Yes	Yes	Yes
2020	N/A	N/A	N/A	Li, Rita Yi Man*; Chau, Kwong Wing; Ho, Daniel Chi Wing; Lu, Weisheng [appendix 2]	A research agenda for neuroactivities in construction safety knowledge sharing, hazard identification and decision making, Advances in Neuroergonomics and Cognitive Engineering, Volume 953, 383-389	2019	Yes	Yes	Yes
2021	N/A	N/A	N/A	Yao, Qi; Li, Rita Yi Man; Song, Lingxi*; Crabbe, M. James C.	Safety knowledge sharing on Twitter: A social network	2022 (first submitted)	Yes	Yes	Yes

				[appendix 3]	analysis, Safety Science				
2022	N/A	N/A	N/A	Luo, Fangsong; Li, Rita Yi Man; Crabbe, M. James C. and Pu, Ruihui* [Appendix 4]	Economic development and construction safety research: A bibliometrics approach, Safety Science	2022 (first submitted)	Yes	Yes	Yes
2022	N/A	N/A	N/A	Yao, Qi; Li, Rita Yi Man; Song, Lingxi* [Appendix 5]	Construction safety knowledge sharing on YouTube from 2007 to 2021: Two-step flow theory and semantic analysis, Safety Science	2022 (first submitted)	Yes	Yes	Yes
N/A	N/A	Yes	N/A	Zhu, Xiaoe; Li, Rita Yi Man, Crabbe, M. James C.* and Sukpascharoen, Khunanan [Appendix 6]	Can chatbot enhance hazard awareness in the construction industry?	2022 (first submitted)	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)*
April/ 2019/ Hong Kong	Ocular behavior in construction hazard decision making process: is neuroeconomics or classical economic theory closer to the reality? (Keynote)	2019 International Conference on Data Mining and Machine Learning (ICDMML 2019) [appendix 7]	2019	Yes	Yes	Yes

June/2019 /Hong Kong	Applied Artificial Intelligence for construction safety	University of Regina Academic Seminar [appendix 8]	2019	Yes	Yes	Yes
June/2019 /Hong Kong	Knowledge sharing and hazard awareness in the construction industry: a global perspective	CIB World Congress 2019 [appendix 9]	2019	Yes	Yes	Yes
Septembe r/2019/Lo ndon	Sharing knowledge via ubiquitous technology to enhance safety awareness: willingness and actual experience in Hong Kong	11th International Conference of CITC Global [appendix 10]	2019	Yes	Yes	Yes
Novembe r /2019/ Thailand	Developing a database to capture, store and share fall-related safety knowledge to enhance fall prevention in construction industry	19th International Conference on Construction Applications of Virtual Reality [appendix 11]	2019	Yes	Yes	Yes
January/ 2020/ Jaipur	A knowledge-based approach for enhancing fall prevention in the construction industry (accepted for publication in Journal of Statistics and Management Systems, see appendix 1)	SUSCOM-2020	2019	Yes	Yes	Yes
July/2020 /San Diego	Building an updated construction safety and built environment research agenda by researching paper indexed in Google Scholar: a natural language processing approach	11th International Conference on Applied Human Factors and Ergonomics [appendix 12]	2019	Yes	Yes	Yes
August/ 2021/ Online	Studying construction hazard awareness via artificial intelligence eye tracking: a tale of three groups of engineers	2021 International Conference on Frontiers of Artificial Intelligence and Machine Learning [appendix 13]	2022 (first submitted)	Yes	Yes	Yes

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

The published works were shared with students during lectures. Two workshops have been organised to teach students how to use an eye tracker to conduct research.

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
[redacted]	[redacted]	[redacted]	[redacted]

12. Other Impact

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

We collaborated with professors from the University of Oxford, Tallinn University of Technology, Srinakharinwirot University, Indian Institute of Technology Guwahati, Rajamangala University of Technology Tawan-Ok, Chongqing Technology and Business University. A book is under preparation by our team.

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	5	7	N/A	N/A	Type	No.
					N/A	N/A

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
N/A	N/A