

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

**FACULTY DEVELOPMENT SCHEME (FDS)**

**Completion Report**  
*(for completed projects only)*

<p><b><u>Submission Deadlines:</u></b> 1. Auditor's report with unspent balance, if any: within <b>six</b> months of the approved project completion date.  2. Completion report: within <b>12</b> months of the approved project completion date.</p>
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**Part A: The Project and Investigator(s)**

**1. Project Title**

Construction Safety Index for Skyscrapers in Hong Kong: A Multi-criteria

Decision-making Approach

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

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	LI, Rita Yi-man	Department of Economics and Finance, Hong Kong Shue Yan University
Co-Investigator	CHAU, Kwong-wing	Department of Real Estate and Construction, the University of Hong Kong
Co-Investigator	POON, Sun-wah	Department of Real Estate and Construction, the University of Hong Kong
Co-Investigator	HO, Daniel Chi-wing	Technological and Higher Education Institute of Hong Kong

**3. Project Duration**

	Original	Revised	Date of RGC / Institution Approval <i>(must be quoted)</i>
Project Start Date	1 Jan 2016	--	--
Project Completion Date	30 June 2018	--	--
Duration <i>(in month)</i>	30	--	--
Deadline for Submission of Completion Report	30 June 2019	--	--

## **Part B: The Final Report**

### **5. Project Objectives**

#### 5.1 Objectives as per original application

1. To construct a construction safety index for skyscrapers in Hong Kong.
- 2.
3. ....

#### 5.2 Revised objectives

Date of approval from the RGC: N/A

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)*

In this research, a systematic literature review was carried out to analyse the immediate and distal causes of construction accidents. Because judges consider the evidences of all stakeholders and record involved in a case, court cases analysis is one most objective source for identifying the causes of construction accidents. As most construction accidents do not require legal recourse, in-depth and face-to-face or telephone qualitative interviews lasting between 30 and 120 minutes were conducted with 44 construction experts in the construction industry, including experienced safety officers, CEOs of the firms and professionals; the goal of this was to determine the five most predominant factors that lead to accidents. Semi-structured interviews allowed for an increase in flexibility while addressing the stakeholders' experiences, thereby diminishing any retrospective biases. We have also conducted interviews with workers who came across accidents before to study the causes of accidents.

The abovementioned court cases and interview results laid a solid foundation for producing the questions in the analytic hierarchy process (AHP) questionnaires, individual experts' experiences are utilised to estimate the relative magnitudes of factors through pair-wise comparisons. Each of the respondents has to compare the relative importance of the two items to build a safety index for skyscraper safety.

The results of the index has been published in Sustainability, a SSCI index 2.592 journal in 2019. Results of the court cases, interviews etc were published in the book "Construction Safety Informatics" in 2019 by Springer and presented in many conferences.

5.4 Summary of objectives addressed to date

<b>Objectives</b> <i>(as per 5.1/5.2 above)</i>	<b>Address</b> <i>(please tick)</i>	<b>Percentage Achieved</b> <i>(please estimate)</i>
1. To construct a construction safety index for skyscrapers in Hong Kong.		100
2.		
3.		
4.		

## 6. Research Outcome

### 6.1 Major findings and research outcome

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

While the systematic review of the previous literature suggested that accidents are caused by a combination of distal and immediate factors, court cases revealed that most of the accidents happened due to fall from a height, and being struck by moving or falling objects. The dynamic system generalized method of moments model results indicated that non-Cantonese speakers receive less compensation<sup>1</sup>. Besides, unlike the labour inspection data, slip, trip, or fall on same level; injured whilst lifting or carrying; and striking against or struck by moving object are the most common causes of accidents, the majority of the construction accidents that end up in court include falls from a height, or being struck by falling or moving objects<sup>2</sup>.

Workers who came across accidents revealed that lack of safety awareness was the major cause of accidents<sup>3</sup>. The interviews among the construction practitioners revealed that (1) the collaboration problem between experienced workers and rookies is a major construction accident cause in new building projects, (2) the ageing problem in the construction industry imposes difficulty for new personnel to find an experienced mentor, and (3) loose regulation increases the safety risks on sites. While many of us consider the contractors who work for the new building projects to be richer with relatively more funding for the project, limited budget for safety ranked first among the new building projects. Academically speaking, this research shows that the generation gap may pose difficulties in communication, and working overtime may lead to accidents, while the extremely long working hours could give rise to accidents at work. These two findings may open a new research agenda in other high-density developed cities with ageing population problems and long working hours. Pair-wise comparisons for new skyscrapers showed that limited budget for safety, followed by project characteristics and regulation, were the most important causes that affect site safety. This offers insight to practitioners and policy makers regarding the means to reduce accidents<sup>4</sup>.

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

*(Maximum half a page)*

There is quite a large difference in risks between different types of the projects such as road, bridge, tunnel and so on. Thus, we will continue to research on these types of projects and compare with the skyscrapers building projects. Another issue identified when we conducted the research is that some accidents happened due to a lack of safety awareness and safety knowledge. That is particularly true among those ethnic minority. Thus, many accidents happened due to these causes.

In view of these, we have started to research on other types of the construction projects' causes of accidents and are investigating the lack of safety awareness and knowledge. Some have been published / presented right after this project finished in June 2018.

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<sup>1</sup> Li, Rita Yi Man; Chau, Kwong Wing; Poon, Sun Wah; Ho, Daniel Chi Wing (2017) Dynamic Panel Analysis on Construction accidents in Hong Kong, *Asian Journal of Law and Economics*, vol. 8(3), pp. 1-9

<sup>2</sup> Li, Rita Yi Man; Chau, Kwong Wing; Poon, Zeng, Frankie (2019) Ranking of Risks for Existing and New Building Works, *Sustainability*, 11(10), 2863

<sup>3</sup> Li, Rita Yi Man (2019) *Construction Safety Informatics*, Springer

<sup>4</sup> Li, Rita Yi Man; Chau, Kwong Wing; Poon, Zeng, Frankie (2019) Ranking of Risks for Existing and New Building Works, *Sustainability*, 11(10), 2863

## **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 apparent transaction costs and asymmetric information suggest that different stakeholders have different perspectives of the relative importance of the factors that lead to accidents. When all the subjective viewpoints are considered, an objective construction safety index for skyscrapers (CSIFS) can be built helping safety officers and employers prioritise expenditure on activities that lower accident rates, implement safety measures and risk plans.

In addition to interviews and questionnaires completed by construction practitioners and safety officers, and case studies of construction accident victims, we included court case reports when building the CSIFS. Knowledge of judges' concerns about the relative importance of accident causation factors helps safety officers, site owners, contractors and developers avoid huge compensation payouts, and provide more relevant training, preventive safety measures and guidelines.

The results help construction practitioners understand the differences between their own and judges' perceptions of accident causes. It provides valuable insights for insurance companies for designing insurance plans, and convey information to government officials about safety regulations for skyscraper design and implementation. As Hong Kong follows a common law system, court case analyses offer useful information for judges who consider stakeholders' liability in construction accidents.

## 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)						
2017	2017			Li, Rita Yi Man*; Chau, Kwong Wing; Poon, Sun Wah; Ho, Daniel Chi Wing	Dynamic Panel Analysis on Construction accidents in Hong Kong, Asian Journal of Law and Economics, vol. 8(3), pp. 1-9	2017	Yes [Appendix 1]	Yes	Yes
2018	2017			Li, Rita Yi Man*; Ho, Daniel Chi Wing; Tang, Beiqi	Factors Which Affect Construction Safety in Different Types of Construction Work, Advances in Safety Management and Human Factors, vol. 604, pp.67-76	2017	Yes [Appendix 2]	Yes	Yes
2018	2017			Li, Rita Yi Man*; Ng, Daniel Ping Lung	Wearable Robotics, Industrial Robots and Construction Worker's Safety and Health, Advances in Intelligent Systems and Computing, vol 595, pp. 31-36	2017	Yes [Appendix 3]	Yes	Yes
2019	2018			Li, Rita Yi Man	Construction safety informatics, Springer, Singapore, pp.1-142 (chapters 2,4,5,7,11)	N/A (first submitted to the RGC in this report)	Yes [Appendix 4]	Yes	Yes

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)						
2019	2019			Li, Rita Yi Man*; Chau, Kwong Wing; Poon, Zeng, Frankie	Ranking of Risks for Existing and New Building Works, Sustainability, 11(10), 2863	N/A (first submitted to the RGC in this report)	Yes [Appendix 5]	Yes	N/A  (link to article online: <a href="https://www.mdpi.com/2071-1050/11/10/2863/htm?fbclid=IwAR0Iz2dkUsSF2-UBCKIMaLlM6yeKwsgz_EolczTD6LQX3gV8Py0khhzQD0Q">https://www.mdpi.com/2071-1050/11/10/2863/htm?fbclid=IwAR0Iz2dkUsSF2-UBCKIMaLlM6yeKwsgz_EolczTD6LQX3gV8Py0khhzQD0Q</a> )
2019		✓		Li, Rita Yi Man	Indirect Costs of Construction Accidents Externalities: Keynesian's Propensity to Consume Approach, International Journal of Environmental Research and Public Health	N/A	Yes [Appendix 6]	N/A	N/A

### 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)
May/2018/ Hong Kong	Construction safety index for skyscrapers in Hong Kong: a multi-criteria decision-making approach	Enhancing Construction Safety and Health in Hong Kong: Learning from Recent Accidents, Collapses and Court Cases	N/A (first submitted to the RGC in this report)	Yes (conference paper 1)	Yes	Yes
April/2019 /Moscow	Biometrics analysis on hazard awareness of construction workers	XXI International Scientific Conference Construction the Formation of Living Environment	N/A (first submitted to the RGC in this report)	Yes (conference paper 2)	Yes	Yes

<b>Month / Year / Place</b>	<b>Title</b>	<b>Conference Name</b>	<b>Submitted to RGC</b> <i>(indicate the year ending of the relevant progress report)</i>	<b>Attached to this Report</b> <i>(Yes or No)</i>	<b>Acknowledged the Support of RGC</b> <i>(Yes or No)</i>	<b>Accessible from the institutional repository</b> <i>(Yes or No)</i>
November 2017, Melbourne, Australia	Asymmetric Viewpoints on Solutions Which Enhance Construction Safety: A Social Network Analysis Approach	22 <sup>nd</sup> International Conference on Advancement of Construction Management and Real Estates, The Chinese Research Institute of Construction Management	2017	Yes (conference paper 3)	Yes	Yes
September 2017, Paris, France	Current-state-of-art in construction safety research and the future agenda [keynote]	244 <sup>th</sup> International Conference on Civil and Architectural Engineering, Paris, France	2017	Yes (conference paper 4)	Yes	Yes
July 2017, Taipei, Taiwan	Leading Safety Indicators and Automated Tools in the Construction Industry [invited paper]	34 <sup>th</sup> International Symposium on Automation and Robotics in Construction, Taipei, Taiwan	2017	Yes (conference paper 5)	Yes	Yes
July 2017, Tokyo, Japan	Construction near misses reporting requirements in Asian and EU countries	European Union Studies Association Asia Pacific Conference	2017	Yes (conference paper 6)	Yes	Yes
June/July 2017, Delft, Netherlands	Building safety index: Structural Equation Modelling approach	24 <sup>th</sup> Annual European Real Estate Society Conference	2017	Yes (conference paper 7)	Yes	Yes
June 2017, San Diego, the US	Construction safety index in Hong Kong	92 <sup>nd</sup> Western Economics Association International Annual Conference	2017	Yes (Conference paper 8)	Yes	Yes
April 2017, Seattle, the US	Construction accident tort cases: mathematical and economic modelling approach	53 <sup>rd</sup> Associated Schools of Construction	2017	Yes (Conference paper 9)	Yes	Yes
January 2017, Bangkok, Thailand	Sense and sensibility: the economics and knowledge of relative importance on causes that lead to accidents on sites [keynote]	3 <sup>rd</sup> International Conference on Business Finance and Management	2017	Yes (Conference paper 10)	Yes	Yes
October 2016, Bern, Switzerland	Asymmetric information of different stakeholders' perception on sustainable and safe building skin construction: a tale of two cities	11 <sup>th</sup> Conference on Advanced Building Skins	2016	Yes (Conference paper 11)	Yes	Yes
November, 2016 Anhui, China	香港建築工人從高處墮下的意外原因及其在法律上的保障 [Invited paper]	安徽財經大學第三屆社會保障研討會	2016	Yes (Conference paper 12)	Yes	Yes
August 2016, Guangzhou, China	Construction safety in Hong Kong skyscrapers [keynote]	2016 Global Conference on Civil and Architectural Engineering	2016	Yes (Conference paper 13)	Yes	Yes



<b>Month / Year / Place</b>	<b>Title</b>	<b>Conference Name</b>	<b>Submitted to RGC</b> <i>(indicate the year ending of the relevant progress report)</i>	<b>Attached to this Report</b> <i>(Yes or No)</i>	<b>Acknowledged the Support of RGC</b> <i>(Yes or No)</i>	<b>Accessible from the institutional repository</b> <i>(Yes or No)</i>
July 2016, Hong Kong, China	Construction Accident Court Cases in Hong Kong	11th Biennial Conference of Asian Consumer and Family Economics Association	2016	Yes (Conference paper 14)	Yes	Yes
June 2016, Seoul, South Korea	Moral hazard and construction accident compensation: an automated Radial-Basis Function neural network approach	12 <sup>th</sup> Annual Asian Law and Economics Association Conference	2016	Yes (Conference paper 15)	Yes	Yes
February, 2016, Colombo, Sri Lanka	Managing construction accident disputes in Hong Kong: a formal institution approach [keynote]	International Multi-disciplinary Research Conference 2016	2016	Yes (Conference paper 16)	Yes	Yes

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

*(Please elaborate)*

Yes, research experience has been shared with those who studied research methodology, property valuation, funding and investment of year 4 undergraduate students as well as graduate students.

#### 11. Student(s) Trained

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

<b>Name</b>	<b>Degree Registered for</b>	<b>Date of Registration</b>	<b>Date of Thesis Submission / Graduation</b>
	Bachelor of Arts (Hons) in Economics and Finance	2012	2016/2016 (Honours project 1)
	Bachelor of Arts (Hons) in Economics and Finance	2013	2017/2017 (Honours project 2)
	Bachelor of Arts (Hons) in Economics and Finance	2013	2017/2017 (Honours project 3)

#### 12. Other Impact

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

Two out of three of my honour project students received the research prize for their construction safety research from the Occupational Safety and Health Research Council in Hong Kong. The research studied construction accident court cases with the help of the Structural Equation Modelling Approach. Thesis studied the impact of asymmetric information on different groups of practitioners' viewpoints regarding the factors that affect construction safety on site.

Thus, their research projects are related to our FDS project. The PI has also received Women researcher award from International Organization of Scientific Research and Development.

Some of the papers are collaborated research with Pro Vice Chancellor/Professor Simon Beecham of the University of South Australia, Professor Zuo Jian from University of Adelaide etc. A book titled *An Economic Analysis on Automated Construction Safety: Internet of Things, Artificial Intelligence and 3D Printing* was published by Springer as a by-product of this research project, because of our interviews with practitioners who shared with us the new technology in the industry. We have also received some overseas keynote presentation invitations, as well as paper presentations from other universities. For example, Prof Mirosław J. Skibniewski, former Associate Provost of Purdue University, invited us to submit a paper to the 34th International Symposium on Automation and Robotics. The PI also acted as a visiting scholar with Distinguished Professor Helen Lingard at the RMIT University, and presented a conference paper in Melbourne.

The research papers are also used for teaching, e.g. the research methods that we used are shared with students. Besides, our research has been reported in the Shue Yan Newsletter.

### 13. Public Access Of Completion Report

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

<b>Information that Cannot Be Provided for Public Access</b>	<b>Reasons</b>
NA	NA

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THE LOCAL SELF-FINANCING DEGREE SECTOR**

**FACULTY DEVELOPMENT SCHEME (FDS)**

**Completion Report - Attachment**

*(for completed projects only)*

**RGC Ref. No.:** UGC/FDS15/E01/15

**Principal Investigator:** LI, Rita Yi-man

**Project Title:** Construction Safety Index for Skyscrapers in Hong Kong: A Multi-criteria Decision-making Approach

**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	16	1 book and 3 book chapters		