RGC Ref. No.:
UGC/IIDS14/B01/21
(please insert ref. above)

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

INTER-INSTITUTIONAL DEVELOPMENT SCHEME (IIDS)

Completion Report
(for completed projects only)

Submission Deadlines:
1. *The unspent balance, if applicable, and auditor's report: 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

Extended reality on smart transport and logistics: embracing innovative theories and technologies for enhancing operational resilience and efficiency

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

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	Dr WONG Yin Cheung, Eugene / Associate Professor	Department of Supply Chain and Information Management, The Hang Seng University of Hong Kong
Co-Principal Investigator(s)	Prof. LO Wai Lun / Professor, Head, Associate Dean	Department of Computer Science, Faculty of Science and Engineering, Hong Kong Chu Hai College
	Dr. LAU Yui-yip / Lecturer	Professional Education and Executive Development (SPEED), The Hong Kong Polytechnic University
Co-Investigator(s)	Dr. Daniel MO / Associate Professor	Department of Supply Chain and Information Management, The Hang Seng University of Hong Kong
	Dr BAI Xiwen / Assistant Professor	Department of Industrial Engineering, Tsinghua University
	Dr. Byron LEE / Past Chairman	Hong Kong Sea Transport and Logistics Association
	Prof. Eugene CH'NG / Professor	Dean, BNU-HKBU United International College
Others	N/A	N/A

3. Project Duration

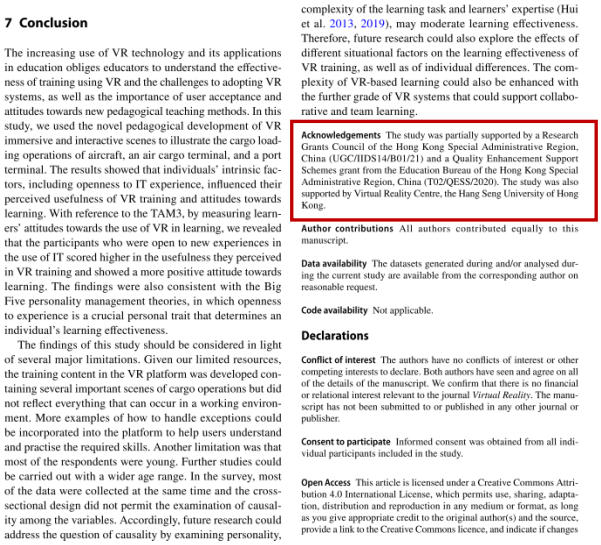
	Original	Revised	Date of RGC / Institution Approval *(must be quoted)*
Project Start Date	1 January 2022		
Project Completion Date	31 December 2022	31 August 2023	27 June 2023
Duration *(in month)*	12 months	20 months	27 June 2023
Deadline for Submission of Completion Report	31 December 2023	31 August 2024	27 June 2023

4.4 Please attach photo(s) of acknowledgement of RGC-funded activities.

- **International Forum on Shipping, Ports and Airports (IFSPA 2022) – Industry Session – Closing Plenary Forum**

- **Asian Logistics, Maritime and Aviation Conference (ALMAC) – Closing Plenary Forum**

- **Journal Paper published in the journal of Virtual Reality**



7 Conclusion

The increasing use of VR technology and its applications in education obliges educators to understand the effectiveness of training using VR and the challenges to adopting VR systems, as well as the importance of user acceptance and attitudes towards new pedagogical teaching methods. In this study, we used the novel pedagogical development of VR immersive and interactive scenes to illustrate the cargo loading operations of aircraft, an air cargo terminal, and a port terminal. The results showed that individuals' intrinsic factors, including openness to IT experience, influenced their perceived usefulness of VR training and attitudes towards learning. With reference to the TAM3, by measuring learners' attitudes towards the use of VR in learning, we revealed that the participants who were open to new experiences in the use of IT scored higher in the usefulness they perceived in VR training and showed a more positive attitude towards learning. The findings were also consistent with the Big Five personality management theories, in which openness to experience is a crucial personal trait that determines an individual's learning effectiveness.

The findings of this study should be considered in light of several major limitations. Given our limited resources, the training content in the VR platform was developed containing several important scenes of cargo operations but did not reflect everything that can occur in a working environment. More examples of how to handle exceptions could be incorporated into the platform to help users understand and practise the required skills. Another limitation was that most of the respondents were young. Further studies could be carried out with a wider age range. In the survey, most of the data were collected at the same time and the cross-sectional design did not permit the examination of causality among the variables. Accordingly, future research could address the question of causality by examining personality, the literature has shown that situational factors, such as the complexity of the learning task and learners' expertise (Hui et al. 2013, 2019), may moderate learning effectiveness. Therefore, future research could also explore the effects of different situational factors on the learning effectiveness of VR training, as well as of individual differences. The complexity of VR-based learning could also be enhanced with the further grade of VR systems that could support collaborative and team learning.

Acknowledgements The study was partially supported by a Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IIDS14/B01/21) and a Quality Enhancement Support Schemes grant from the Education Bureau of the Hong Kong Special Administrative Region, China (T02/QESS/2020). The study was also supported by Virtual Reality Centre, the Hang Seng University of Hong Kong.

Author contributions All authors contributed equally to this manuscript.

Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Code availability Not applicable.

Declarations

Conflict of interest The authors have no conflicts of interest or other competing interests to declare. Both authors have seen and agree on all of the details of the manuscript. We confirm that there is no financial or relational interest relevant to the journal *Virtual Reality*. The manuscript has not been submitted to or published in any other journal or publisher.

Consent to participate Informed consent was obtained from all individual participants included in the study.

- **Journal Paper published in the journal of Computers in Human Behavior**

transportation and logistics. However, the investigation of haptic stimulus is crucial in this field given that studies have commonly involved the control of machines and carriers. A high-quality haptic experience will enhance the realism and efficacy of VR systems. However, instead of desktop haptics or surface haptics, researchers in transportation and logistics should focus on improving the quality of wearable haptics. The advancement of haptic technologies in recent years (Perret & Vander Poorten, 2018) should be exploited by researchers to identify ways to design and develop wearables specifically for transportation and logistics. Nevertheless, any wearable haptic device may struggle to replace common gloves; this is a challenge that future researchers must overcome.

7. Conclusion

This paper provides readers with a comprehensive, relatively objective review of state-of-the-art VR-based research in the field of transportation and logistics. Specifically, four categories are focused with reference to the mode of transportation: air, maritime, railway and road transportation and logistics. The systematic review facilitates readers to understand the landscape of the existing studies in the field of transportation and logistics. Six research clusters have been identified, representing the main themes discussed among scholars in this field in the last decade. The clusters serve as steppingstones for researchers to explore this field in future. They also provide managerial implications and insights for practitioners to improve their business models and operations. Cluster 1, 2 and 5 illustrate the use of VR for training on operations skills and incident handling is becoming more mature and widely accepted by the industry practitioners. Safety, fire evaluation simulation, and vehicle maintenance are areas that could be well applied with immersive training. The results shown in Cluster 3 shows the increasing acceptance for the use of VR in staff training and development, considering the increase in instructor costs, limited availability of training sites, and safety concerns for transport or logistics onsite trainings, for examples container terminals, airports, warehouse and vehicles. VR can lower the training costs and facilitate training anytime anywhere. Results in cluster 4 illustrate the success of extending the applications of VR in logistics and transport from training to operations enhancements, infrastructural design, and transport planning.

Based on our review and clustering analysis, we propose research directions for specific categories of transportation and logistics and for the overall field of transportation and logistics. We provide readers with a roadmap for future exploration, and we hope that this review thus inspires and aids researchers to explore new VR-based applications in transportation and logistics. The study has some limitations. First, similar to some previous studies, such as Ngai and Lee (2016), the final set of studies that we collected may not be exhaustive. However, we consider that we reviewed a sufficiently high number of studies to in logistics and transport to operations enhancements, infrastructural design, and transport planning could be investigated. This could be achieved by integrating VR with other advanced technologies, for example machine learning, sensor technologies, Internet of Things, and blockchain.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Acknowledgment

The work described in this paper was partially supported by Research Grants Council of the Hong Kong Special Administrative Region, China (UGC/IIDS14/B01/21) and a grant Quality Enhancement Support Schemes from the Education Bureau of the Hong Kong Special Administrative Region, China (T02/QESS/2020).

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Becker, L., Toivonen, V., & Leino, S. P. (2011). Using virtual reality in designing the assembly process of a car. In *DS 68-9: Proceedings of the 18th international conference*

- **Additional talk on 'Challenges and outlook in leading and connecting people, technology and environment for logistics business in Hong Kong and Greater Bay Area'.**

Part B: The Final Report

5. Collaboration with Other Self-Financing Degree-Awarding Institutions

	Name of Institution(s)	% of Participation	Distinctive Element(s) of the Institution in Responsible Project
Applying Institution	The Hang Seng University of Hong Kong	70%	IFSPA International Forum, IAME International Conference Plenary Forum, Case studies, Research paper, and Education case reference book.
Collaborating Institution(s) (If any) #	Hong Kong Chu Hai College	15%	IFSPA International Forum, IAME International Conference Plenary Forum, and Case studies.
	Professional Education and Executive Development (SPEED), The Hong Kong Polytechnic University	15%	IFSPA International Forum, IAME International Conference Plenary Forum, and Education case reference book.
Total:		100%	

*If no other eligible local self-financing degree-awarding institutions are involved, please input "**N/A**" in this table.*

6. Project Objectives

6.1 Objectives as per original application

1. *To explore the most recent research potentials of ER in the maritime, aviation and logistics industries from the perspectives of technological advancement and development as well as research applications and user effectiveness.*
2. *To facilitate research and teaching in the areas of ER and their integration of other technologies in maritime, aviation and logistics.*
3. *To prepare students for careers in the advanced technological development of logistics, supply chain or transportation industries by familiarizing them with ER via case-based workshops and seminars.*
4. *To provide a knowledge-based research and teaching platform with the most up-to-date case studies on VR and AR applications in maritime and aviation logistics tailored to supply chain and logistics students, academics and practitioners.*
5. *To enhance the media available for teaching and learning in the field of technology management with modules on various logistics, transport and supply chain programmes.*

6.2 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

6.3 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)

Objective 1: To explore the most recent research potentials of ER in the maritime, aviation and logistics industries from the perspectives of technological advancement and development as well as research applications and user effectiveness.

(1) Organised an international plenary forum and an international conference plenary forum with latest potential research areas, technologies and applications of VR, AR, and Metaverse being explored and identified.
(2) Organised additional talk: (i) Challenges and outlook in leading and connecting people, technology and environment for logistics business in Hong Kong and Greater Bay Area, gaining insights from speakers.

Objective 2: *To facilitate research and teaching in the areas of ER and their integration of other technologies in maritime, aviation and logistics.*

(1) Conference are carried out: Wong, E.Y.C., Ling, K.K.T. (2022) An Immersive Visualisation for Cargo Unit Load Device Building-up Operations Optimisation. International Associate of Maritime Economics (IAME) Conference 2022. 14-16 September 2022. Korea. (Annex I)
(2) Two journal papers are published:
   - Wong, E. Y. C., Hui, R. T. Y., & Kong, H. (2023). Perceived usefulness of, engagement with, and effectiveness of virtual reality environments in learning industrial operations: the moderating role of openness to experience. Virtual Reality, 1-17. (Annex II)
   - Wong, E. Y. C., & Lee, P. T. Y. (2024). Virtual reality in transportation and logistics: A clustering analysis of studies from 2010 to 2023 and future directions. Computers in Human Behavior, Vol. 153, 108082. (Annex III)
(3) An education reference book with principles, theories, applications and cases studies on virtual reality has been compiled. (Annex IV)

Objective 3: To prepare students for careers in the advanced technological development of logistics, supply chain or transportation industries by familiarizing them with ER via case-based workshops and seminars.

(1) Organised international plenary forum, international conference plenary forum, and seminar talk for students to understand the technology development and applications of ER on logistics.
(2) Carried out illustrations and demonstrations of virtual reality and its applications during academic class teaching.

Objective 4: To provide a knowledge-based research and teaching platform with the most up-to-date case studies on VR and AR applications in maritime and aviation logistics tailored to supply chain and logistics students, academics and practitioners.

(1) The cases in the education reference book, for example, the use of VR for learning in Hactl and the collaborative learning on cargo screening in DHL Express, are shared for teaching and learning.

(2) An additional talk, with the topic of 'Challenges and outlook in leading and connecting people, technology and environment for logistics business in Hong Kong and Greater Bay Area', was organised for teaching and research. Managing Director of Crown Logistics shared useful insights and cases. Academics and industrial practitioners are also invited. The presentation material was shared in the Moodle learning platform for teaching and learning.

Objective 5: *To enhance the media available for teaching and learning in the field of technology management with modules on various logistics, transport and supply chain programmes.*

(1) The compiled cases and the information collected from the international forums are shared on the website and Moodle for academic programmes.
(2) The events and news of the international plenary forum and international conference plenary forum are posted and shared on the public websites.

6.4 Summary of objectives addressed to date

Objectives	**Addressed** *(please tick)*	**Percentage Achieved** *(please estimate)*
1. To explore the most recent research potentials of ER in the maritime, aviation and logistics industries from the perspectives of technological advancement and development as well as research applications and user effectiveness.	✓	100%
2. To facilitate research and teaching in the areas of ER and their integration of other technologies in maritime, aviation and logistics.	✓	100%
3. To prepare students for careers in the advanced technological development of logistics, supply chain or transportation industries by familiarizing them with ER via case-based workshops and seminars.	✓	100%
4. To provide a knowledge-based research and teaching platform with the most up-to-date case studies on VR and AR applications in maritime and aviation logistics tailored to supply chain and logistics students, academics and practitioners.	✓	100%
5. To enhance the media available for teaching and learning in the field of technology management with modules on various logistics, transport and supply chain programmes.	✓	100%

6.5 Project progress

Original Implementation Schedule	**Revised Implementation Schedule (Date of RGC's Approval)**	**Updated Progress**
A research session has been successfully carried out: *International Forum on Shipping, Ports and Airports (IFSPA 2022) – Closing Plenary Forum – Emerging Extended Reality and Innovative Technologies for Smart Transport and Logistics* on 19 May 2022.	N/A	Over 380 participants, including professors, scholars, industry practitioners, staff and students, from over 10 countries attended the forum.
An international forum has been successfully held: *Asian Logistics, Maritime and Aviation Conference (ALMAC) - Closing Plenary Forum Leading in the new era - advancing global trading and logistics with emerging technologies in a dynamic landscape* on 23 November 2022.	N/A	Over 300 academics, scholars, industry practitioners and students, from local and overseas, participated the event.
A conference presentation has been attended with abstract titled "An Immersive Visualisation for Cargo Unit Load Device Building-up Operations Optimisation".	N/A	A conference presentation is conducted with abstract titled "An Immersive Visualisation for Cargo Unit Load Device Building-up Operations Optimisation" in IAME 2022 International Conference.
A journal paper has been compiled, submitted and accepted. It has been published in journal of Virtual Reality.	N/A	A paper titled "Perceived usefulness of, engagement with, and effectiveness of virtual reality environments in learning industrial operations: The moderating role of openness to experience" has been published in the journal of Virtual Reality (IF: 4.697 Q1).
A journal paper has been compiled, submitted and accepted. It has been published in journal of Computers in Human Behavior.	N/A	A paper titled "Virtual reality in transportation and logistics: A clustering analysis of studies from 2010 to 2023 and future directions" has been published in the journal of Computers in Human Behavior (IF: 9.9)
Education reference book with case studies.	N/A	The education reference book has been compiled.

6.6 Speaker(s)

Title / Name (Surname in Capital Letters)	**Post / Institution**	**Title / Topic of Presentation / Course**	**Previous Research Links with Hong Kong Institutions** (Nature and Date (Month / Year))
Dr. Michael GRIEVES	Chief Scientist, Executive Director, Digital Twin	Innovations on Digital Twins: IoT, AI, ML, VR, AR	https://www.researchgate.net/profile/Michael_Grieves
Prof. Andrew NEE	Professor Emeritus, National University of Singapore	Augmented Reality (AR) and Digital Twin Applications in Engineering	https://www.eng.nus.edu.sg/me/staff/nee-yeh-ching-andrew/
Dr. Chung NG	Senior Vice President, Technology Strategy and Development, Hong Kong Telecom	AR-based metaverse and 5G for intelligent service operations	https://www.topionetworks.com/people/chung-ng-5e18383778e0021fe65b3903
Mr. Jimmy PANG	President, Supply Chain Safety and Security Association	Trends of VR on logistics and transport in post COVID-19 pandemic	https://www.linkedin.com/in/jimmy-pang-b206a76/?originalSubdomain=hk
Mr. Eric POON	Head of Performance Enhancement, HACTL	Performance Enhancement in Aviation Logistics through Extended Reality and Innovative Technologies	https://www.linkedin.com/in/eric-poon-6b982645/?originalSubdomain=hk
Dr. Graziano TERENZI	CEO, Inglobe Technologies	Augmented Reality, Robotics and Human Factors in Logistics	https://www.researchgate.net/profile/Graziano-Terenzi
Dr Jan HOFFMANN	Chief, Trade and Logistics Branch, United Nations Conference on Trade and Development, Geneva, Switzerland	Global Trading and Logistics Business: A New Area?	https://janhoffmann.live/about/
Dr. Guang CHEN	Partner, McKinsey, Hong Kong	Value creation in the metaverse and product innovation for aviation and maritime logistics sectors	https://www.linkedin.com/in/guang-chen-a9777223/?originalSubdomain=hk
Mr. Chee Choong NG	Senior Vice President & Managing Director, DHL Express Hong Kong & Macau	Outlook on driving corporations on air cargo operations with virtual reality and emerging technologies	https://www.linkedin.com/in/cheechoong-ng-fcilt-44442720/?originalSubdomain=hk

Title / Name (Surname in Capital Letters)	**Post / Institution**	**Title / Topic of Presentation / Course**	**Previous Research Links with Hong Kong Institutions** (Nature and Date (Month / Year))
Mr. John PARKES	Managing Director, Integrated Logistics, Kerry Logistics	Next generation of technologies for contract logistics after the new normal	https://www.linkedin.com/in/johnlparkes/?originalSubdomain=hk
Dr. Graziano TERENZI	CEO, Inglobe Technologies, Italy	Advancing to Industry 4.0 with Augmented Reality: Used Cases on Huawei and ABB Robotics	https://www.researchgate.net/profile/Graziano-Terenzi
Mr. Kelvin KO	CEO, BPS Logistics Technology	Advancing global trading and logistics with emerging technologies in a dynamic landscape	https://www.bps-au.com/kelvin-ko
Mr. Billy Wong	Managing Director, Greater China, Crown Worldwide Group	Challenges and outlook in leading and connecting people, technology and environment for logistics business in Hong Kong and Greater Bay Area	https://www.linkedin.com/in/billy-wong-8b396413/?originalSubdomain=hk

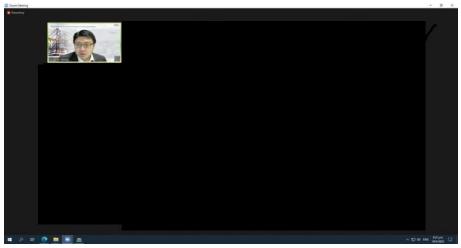
6.7 Please provide details of the activities organized, including the theme / objectives of the activities, targeted participants, attendance, analysis of participants, e.g. country of origin, research background, etc., evaluation forms of the activities and a summary of the participants' evaluation. Photos of the activities are preferred.)

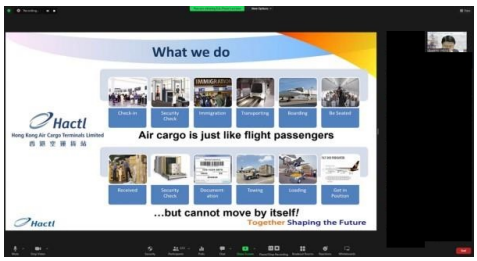
[1] International Forum on Shipping, Ports and Airports (IFSPA 2022) – Closing Plenary Forum

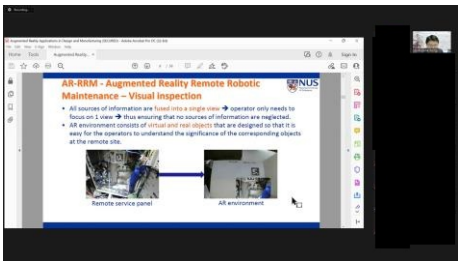
- **Themes:** Emerging Extended Reality and Innovative Technologies for Smart Transport and Logistics
- **Objectives:** To exchange views and explore emerging ER technologies and identify their research and practical implications for transport and logistics operations.
- **Date:** 19 May 2022 (Thursday)
- **Time:** 6:00pm – 7:45pm HKT
- **Venue:** Online Zoom Platform
- **Targeted participants:** Students, academics, scholars and industry practitioners.
- **Attendance:** 383 participants attended
- **Analysis of participants:** The participants include professors, scholars, industry practitioners, staff and students, coming from Hong Kong, China, Singapore, Australia, Brazil, Belgium, Taiwan, Italy, United Kingdom, Uzbekistan, and United States.

- **Summary of participants' evaluation:** Survey and verbal feedback were collected. Positive comments were received from the respondents. Many are interested to know more about technologies and applications of VR. A feedback survey form link has been sent out to the participants. The questions in the form included:
  (1) What is your overall evaluation of the forum? (1=Most Dissatisfied, 7=Most Satisfied)
  (2) What aspects of the forum were of most value to you?
  (3) Do you have any additional feedback for the organiser or speaker of the forum?
  (4) Please list suggestions for topics and speakers for future regional industry session forum.

  There were 16 responses. Below is the summary of the responses:
  Most of the respondents were satisfied with the forum session, with a rating of 6.125 out of 7. The respondents revealed their interests in the topics relating to the principles and applications of VR, AR, AI and other related technologies on logistics. They have also shown their great interest in the topics related to Metaverse, AI, digital twin and sustainability.
- **Website news articles:**
  News 1: https://scm.hsu.edu.hk/us/news/news/415
  News 2:
  https://vrbd.hsu.edu.hk/international-forum-on-emerging-extended-reality-and-innovative-technologies-for-smart-transport-and-logistics/
- **Photos:**







[2] Asian Logistics, Maritime and Aviation Conference (ALMAC) - Closing Plenary Forum

- **Themes:** Leading in the new era - advancing global trading and logistics with emerging technologies in a dynamic landscape
- **Date:** 23 November 2022 (Wednesday)
- **Time:** 4:30pm – 5:30pm HKT
- **Venue:** Hong Kong Convention and Exhibition Centre, Wan Chai, Hong Kong
- **Objectives:** The forum aims to facilitate leaders of the industry to share insights on what strategies should a leader take in for driving innovation and technologies in transport and logistics operations under the global trends of VR, Metaverse, AI, 5G, and digitalization. The forum invited leaders from various dimensions to share views, strategies and outlook in bringing innovations in dynamic trading and business environments.

- **Description and Highlights:** Leaders in the logistics, maritime and aviation industry are continuously driving innovations and improvements in navigating business under the dynamic trading environment. Motivating changes under the global trends of AI, 5G digitalisation and Metaverse technologies is inevitable to maintain competitiveness, improve productivity and reduce cost. What strategies should a leader take in for driving innovation and technologies in transport and logistics operations? This session invites leaders from various dimensions to share views, strategies and outlook in bringing innovations in dynamic trading and business environments.
- **Targeted participants:** Degree and MSc students, academics, scholars and industry practitioners.
- **Attendance:** About 300 participants attended.
- **Analysis of participants:** The participants come from local and overseas, including students, academics, scholars, government officials and industry practitioners.
- **Summary of participants' evaluation:** Survey and verbal feedback were collected from the participants. A feedback survey form link has been sent out to the participants. The questions in the form included:
  (1) What is your overall evaluation of the ALMAC Closing Plenary Forum?
  (2) What aspects of the ALMAC Closing Plenary Forum were of most value to you?
  (3) How comfortable did you feel sharing your opinions in the ALMAC Closing Plenary Forum?
  (4) How likely is it that you would recommend the ALMAC Closing Plenary Forum to a friend or colleague?
  (5) Do you have any additional feedback for the organisers or speakers of the ALMAC Closing Plenary Forum?

  There are 23 respondents: All were satisfied with the Asian Logistics, Maritime and Aviation Conference (ALMAC) Closing Plenary Forum (average of 6.04 out of 7), and all of them indicated that they were very likely to recommend the Closing Plenary Forum to people around them (average of 6.13 out of 7). They found the content were valuable to them, particularly the information regarding the virtual reality technologies and applications in the logistics and transportation industry, in the aspects of trading, supply chain consolidation, freight forwarding, as well as the global technology trends.
- **Website news articles:**
  News 1: https://vrbd.hsu.edu.hk/category/news/page/2/
  News 2:
  https://gscm.hsu.edu.hk/en/the-12th-asian-logistics-maritime-and-aviation-conference-almac-international-plenary-forum/
- **Photos:**





[3] Additional Talk - Challenges and outlook in leading and connecting people, technology and environment for logistics business in Hong Kong and Greater Bay Area

- **Date:** 13 October 2022 (Wednesday)
- **Time:** 4:30pm – 5:30pm HKT
- **Venue:** Lecture Theatre A401, The Hang Seng University of Hong Kong
- **Speaker:** Mr. Billy Wong, Managing Director, Greater China, Crown Worldwide Group
- **Targeted participants:** Students, academics, scholars and industry practitioners.
- **Attendance:** About 160 participants attended.
- **Highlights and feedback:** Academics, staff and students attended the talk. The speaker shared experiences, views and insights in leading and driving technologies in the third-party logistics business and operations.
- **Website news articles:** https://gscm.hsu.edu.hk/en/gscm-leadership-talk-7-leading-through-caring-2/
- **Photos:**

7. Research-Related Outcome

7.1 Potential for development into research proposal and the proposed course of action *(Maximum half a page)*

- A comprehensive literature review on virtual reality on transportation and logistics was carried out with detailed analysis. The analysis is further compiled into a journal paper and published in the journal of Computers in Human Behavior.
- Research on adaptive and collaborative learning on virtual reality Metaverse on cargo operations and safety is identified.
- The applications of virtual reality have been extended to other disciplines, with proposals on title ‘Transmission and Conditionality: develop an effective methodology for the teaching and learning Chinese martial arts’ submitted to the research grant council fundings.

7.2 Research collaboration achieved
(Please give details on the achievement and its relevant impact)

- Collaborated with Hong Kong Chu Hai College and Professional Education and Executive Development (SPEED), The Hong Kong Polytechnic University in organizing forums and talk seminar about virtual reality and augmented reality in transport and logistics.
- Collaborated with Hong Kong Shue Yan University in compiling and publishing a journal paper on clustering analysis of studies on virtual reality in transportation and logistics and published in the journal Computers in Human Behavior.
- Collaborated with NUCB Business School, Nagoya University of Commerce and Business in compiling a paper about the learning effectiveness of virtual reality.
- Collaborated with SPEED in compiling an education reference book on virtual reality and Metaverse.

7.3 Any new development and/or challenging research topic(s) has / have been identified and any new initiative(s) for future research has / have been inspired.

- New development or challenges research topics identified and new initiatives for future research: Further research on adaptive learning on logistics operations through Metaverse virtual reality systems.
- Connected to academics in the University of Hong Kong, National University of Singapore, and Technical University of Denmark for research collaboration opportunities.

8. The Layman's Summary

(Describe <u>in layman's language</u> the nature, significance and value of the research activities, in no more than 200 words)

The rapid adoption of extended reality (ER) in the worldwide logistics and transport sector has created an urgent need for technological advancement and research development to provide the solutions and support required in daily operations. Research on ER and its integration with other advanced technologies, including big data analytics, digital twin, Internet of Things (IoT) and artificial intelligence (AI), has been actively carried out in many industries, but few studies can be found in the transport and logistics sector. Developed countries have already devoted research to these areas, e.g. remote operation of unmanned surface vessels via VR, vessel navigation systems, automatic identification system and global positioning system, digital twin with VR and AR, 5G, etc. More resources must be devoted to embracing new theories and innovative technologies in this area because Hong Kong currently lags behind many other countries with advanced ER technologies. In view of these needs, this project organised international forums tailored for logistics practitioners to discuss innovations in ER for maritime and aviation logistics. The participants explored both local and overseas case studies. The deliverable provided detailed insights tailored to students and practitioners using the up-to-date cases from Hong Kong, China and the broader region.

(198 words)

Part C: Research Output

9. Recognized Conference(s) Paper(s) Related To This Project Was / Were Delivered *(As Applicable)*

(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)*	**Acknowl-edged the Support of RGC** *(Yes or No)*
Sept / 2022 / Busan, South Korea	An Immersive Visualisation for Cargo Unit Load Device Building-up Operations Optimisation	IAME 2022 International Conference	2024	Yes (Annex I)	Yes

10. Research Personnel Trained *(As Applicable)*

Name	**Capacity**
	Research Assistant
	Research Assistant

11. Other Impact *(As Applicable)*

(e.g. prizes, collaboration with other research institutions, technology transfer, etc.)

- A journal paper about perceived usefulness of, engagement with, and effectiveness of virtual reality environments in learning industrial operations has been accepted and published in the journal of Virtual Reality (Impact Factor: 4.697). The research work is collaborated with NUCB Business School, Nagoya University of Commerce and Business.

- A journal paper about clustering analysis of literature studies on virtual reality in transportation and logistics has been published in the journal of Computers in Human Behavior (Impact Factor: 9.9). The research work is collaborated with the Hong Kong Shue Yan University.

- A reference book about the principles and applications of virtual reality has been compiled and published. The research work is collaborated with Professional Education and Executive Development (SPEED), The Hong Kong Polytechnic University.

- Collaborated with Hong Kong Chu Hai College, Professional Education and Executive Development (SPEED), The Hong Kong Polytechnic University, Tsinghua University, Hong Kong Shue Yan University, The University of Hong Kong, Hong Kong Trade Development Council, university research centres, and other logistics, transport, and engineering industry associations in organizing international forums and seminar talk.

12. 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 project	2	1	1	N/A	Type	No.
					N/A	N/A

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