出國報告（出國類別：國際會議）

赴日本石川金澤參加
第 20 屆亞太工業工程與管理系統研討會
The 20th Asia Pacific Industrial Engineering and Management System Conference (APIEMS 2019)
心得報告

服務機關：國防大學財務管理學系
姓名職稱：楊志豪副教授
派赴國家：日本
出國期間：108 年 12 月 01 日至 12 月 06 日
報告日期：108 年 12 月 26 日

摘要

為與國際「數量方法與作業研究」學術領域之先進議題接軌，並與領域學者進行有效交流，個人有幸獲得科技部經費補助，前往日本石川金澤市參加 **The 20th Asia Pacific Industrial Engineering and Management System Conference (APIEMS 2019)**國際研討會，並以論文名稱「**The application of a multi-decision model for circular economy business model innovation for the green energy industry**」一題投稿接受口頭發表。APIEMS 為科技部管理二學門表列之具代表性國際學術會議，此次 APIEMS 2019 國際學術研討會與個人研究領域相關議題包括決策模型與理論(Decision Modeling)、決策支援與專家系統 (Decision Support System and Expert System)、永續管理(Sustainable Management)及作業研究(Operation Research)等新興議題領域。本次參加國際研討會，個人於國際研討會所發表的成果為個人申請通過 108 科技部兩年期計畫「**綠能產業鏈共生循環經濟實踐之多元決策模式建構與應用**」之部分成果發表，發表過程有幸與國外學者進行意見交流，有助於個人研究學術新知增進，期許個人將研究計畫之研究成果發表至高品質之國際期刊。

目次

壹、目的

為與國際「數量方法與作業研究」學術領域之先進議題接軌，並與領域學者進行有效交流，個人有幸獲得科技部經費補助，前往日本石川金澤市參加 **The 20th Asia Pacific Industrial Engineering and Management System Conference (APIEMS 2019)**國際研討會，並以論文名稱「**The application of a multi-decision model for circular economy business model innovation for the green energy industry**」一題投稿接受口頭發表。APIEMS 為科技部管理二學門表列之具代表性國際學術會議，此次 APIEMS 2019 國際學術研討會與個人研究領域相關議題包括決策模型與理論(Decision Modeling)、決策支援與專家系統(Decision Support System and Expert System)、永續管理(Sustainable Management)及作業研究(Operation Research)等新興議題領域。

本次參加 APIEMS2019 國際研討會主要目的為與國際學者進行學術交流、討論與學習，並擇選與個人研究相近之國際學者之口頭發表場次，吸取作業研究領域新興議題新知；同時今年 APIEMS2019 於日本金澤舉行，個人亦深刻體驗日本北陸城市發展及替代能源推動之豐碩成果。

APIEMS 2019 舉辦地點 日本石川金澤

APIEMS 2019 舉辦地點 HOTEL KANAZAWA

貳、過程

The 20th Asia Pacific Industrial Engineering and Management System Conference (APIEMS 2019) 國際研討會於 108 年 12 月 02 日~12 月 05 日於日本石川縣金澤市舉行，投稿件於 108 年 8 月 30 日投稿，10 月 13 日提供審查意見，作者修改回覆後並於 11 月 9 日審查接受，於 12 月 01 日啟程出發抵達日本石川縣，12 月 02 日~12 月 05 日為會議期間，並於 12 月 06 日搭機返國。12 月 02 日開始註冊，12 月 3 及 4 日分別舉辦專題講演，針對當前工業工程與作業研究領域新興議題提出不同見解與想法，提供與會學者創新研究理念，亦使個人日後進行新興議題研擬及結合作業研究與數量方法之方向時具有參考價值。專題名稱與講員如下:

發表人於會場與海報合影

1. How Big Data can help people with developmental disabilities: as with Kampo medicine, the treatment formula is different for different individuals.

   Speaker: Prof. Chika Mouri (Toyama University, Japan)

2. From integration to augmentation, from interaction to collaborative control — IE/MS frontiers for future work and factories, Prof. Speaker: Shimon Y. Nof (Purdue University, USA)

3. New arena for industrial engineering and management science in the techdriven era, Speaker: Dr. Kenichi Funaki (Hitachi, Ltd., Japan).

本人發表的論文安排於 12 月 04 日下午 1330 時開始，場次為 Operation Research，首先，主持人韓國 POSTECH 大學 Prof. Byung-In Kim 進行發表人介紹。隨後由本人進行論文口頭發表及接受現場學者提問與討論。本人除表達研究成果分享外，亦結合研究主題分享「台灣」推動智慧城市與智慧醫療政策之決心。與會學者中韓國 POSTECH 大學 Prof. Byung-In Kim 對於本人發表研究發現富興趣，提問決策方法選擇與議題之相關性，並對於循環經濟商業模型內容進行深入討論，亦建議納入進行企業個案實證可能會有更顯著之研究發現等建議。

同時，台日韓對於循環經濟與再生能源發展均不遺餘力，研究議題與成果亦引起在座學者共鳴。此外，會議期間亦前往與個人研究領域相關之的場次，聆聽新興的研究方法與研究發現，期許觸發新興研究議題，未來應用於作業研究與數量方法之學術領域。

發表人於會場內發表

會場發放用品

參、心得與建議

第 20 屆亞太工業工程與管理系統研討會 The 20th Asia Pacific Industrial Engineering and Management System Conference (APIEMS 2019)結合高品質理論與實務之學術論壇，歷年研討會論文均經過嚴格審查，始可進行發表。APIEMS 2019 於日本石川金澤市舉辦，來自各國家約 300 餘名學者專家共襄盛舉。

本人於此次研討會中所發表的論文為：『**The application of a multi-decision model for circular economy business model innovation for the green energy industry』(綠色能源產業之循環經濟商業模式創新決策模型應用研究)**，其係探討綠色能源產業之循環經濟商業模式優化組合評估為永續發展策略有助於社會與經濟發展。本研究發展整合決策模型應用整合決策實驗室法(DEMATEL)及分析網絡法(ANP)評估循環經濟商業模式創新策略（包括綠色能源產業聚落，回收平台交換，產品租賃和服務共享以及創新輕量化設計）。為了解決資源限制下之策略優化組合評估，本研究將資源需求納入 0-1 目標規劃(ZOGP)模型，以促進綠色產業永續發展。本研究的主要貢獻為提供多準則決策(MCDM)技術整合至綠色能源產業之循環經濟商業模式優化組合評估。學術領域貢獻，本研究將循環經濟概結合資源限制，建構商業模式創新策略之數學規劃決策模型；產業領域貢獻，決策模型提供綠能產業了解評估觀點與準則，並了解合理資源分配方式；政策領域貢獻，本研究針對綠色能源產業之永續發展政策提供優化循環經濟商業模式評估解決方式。本次研討會不乏許多與「永續環境」與「商業模式」相關之研究發表，顯見「循環經濟」議題之國際重視程度。個人研究領域主以多準則決策分析及數學規劃模型結合，自永續公共建設、再生能源、智慧能源領域、智慧城市產業至近年探討循環經濟，透過國際研討會參與，更深化個人研究領域長期耕耘之決心。國家永續發展目標下之環境、經濟及社會間均衡，應以系統性解決思維為基礎，納入不同影響層面的考量，以尋求整體國家系統解決之道。當前政府持續推動國家永續發展政策，提出「五加二產業創新」的經濟新模式。其中，「循環經濟」為現階段主要驅動台灣下世代產業成長的核心關鍵因素之一，新興商業模式與產業鏈的興起始可為經濟成長注入新動能。

本次參加研討會乃難得寶貴經驗，透過研究成果之分享與同場次的學者相互交流、交換意見。感謝科技部經費補助國際研討會，使個人有機會將個人研究成果於國際會議場合分享，同時在積極推動綠色能源之國家--日本，了解城市運用綠能之普及性，有助於個人未來在新興議題之發想。同時，因應國家永續發展政策，建議國防部及公部門推動之新興替代能源政策應納入循環經濟概念發想，進而參考商業模式創新，結合現有產業服務特性，有效提供計畫執行與績效創造。

肆、附錄

1. APIEMS2019 簡要議程與論文發表場次資料：

資料來源: APIEMS2019 官方網站(http://www.apiems2019.org/)
(擷取日期:2019/12/01)

	Session 4 10:30– 12:10(12:25)	Quality Engineering and Management 2	OS: Work-life Balance and Services 2 (JIMA)	OS: Perspectives on Data Analytics 3 (JIMA)	OS: Management Mathematics 2 (JIMA)	Productions and Operations Management 1	Industrial Engineering /Automation 2	Management Information System/Management Information System 2	Engineering Economy/Financial Models
		336 174 175 51 151 111 155	132 163 170 338	188 210 101 304 366 200	121 63 324 56 12 119	193 71 72 85 52 95	214 185 197 171 272	159 340 344 350 388 312	103 104 46 34 212 303
12/4 (Wed)	12:10–13:30	Lunch (2F Diamond)							

Session 5 13:30– 15:10(15:25)	Operation Research 1	OS: Work-life Balance and Services 3 (JIMA)	OS: Perspectives on Data Analytics 4 (JIMA)	OS: Management Mathematics 3 (JIMA)	Productions and Operations Management 2	Big Data Methodology and Application 1	Ergonomics/ Human Factor 2	Artificial Intelligence 1
	84 263 359 255 370 131	204 225 247 278 326 341	187 135 124 327 293	89 30 32 20 152	184 227 246 328 371 264 235	198 218 164 86 87 90	118 139 140 144 285 23 217	297 325 347 294 43 55 13
Coffee Break (5F)								

Operation Research 1　　12/4　13:30~　　Room 1

84	The Multi-profit Orienteering Problem
	Hyunjoon Kim, Byung-In Kim and Dong-Jin Noh
263	Analysis of G(t)/G(t)/s(t) queue system in non-stationary customer arrival pattern using infinite server method: A case study in Supermaket
	Utaminingsih Linarti and Feby Z Hadi
359	The application of a multi-decision model for circular economy business model innovation for the green energy industry
	Chih-Hao Yang
255	Scheduling Linear Deteriorating Jobs on a Single Machine with a Rate-modifying Activity to Minimize Makespan
	Hui-Chih Hung, Hsi-Mei Hsu and Chiang-Lin Chao
370	A multi-depot vehicle routing problem with order split and allocation in e-commerce logistics
	Tao, Lin and Wei
131	Heavy Item Truck Loading Problem with Real-World Constraints
	Jonghwa Lee and Byung-In Kim

2.研討會發表簡報

The application of a multi-decision model for circular economy business model innovation for the green energy industry

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I.INTRODUCTION

- The green energy industry has been one of the key investment industries in terms of national economic innovation development, in Taiwan.
- Numerous countries are currently attempting to promote a green energy policy in order to slow global climate warming due to CO_2 emissions, especially in the electricity and heat generation sector

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I.INTRODUCTION

- Photovoltaic (PV) power is the main energy source for achieving a sustainable energy goal.

Challenge

Related to environmental sustainability in green energy production, and in operational and waste processes for the green energy.

Solution

Circular Economy (CE) is an approach that promotes the responsible and cyclical use of resources.

→ Develop business model innovation

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I.INTRODUCTION

- The purpose of this study is to develop an optimal decision model for circular economy business model innovation for the green energy industry and obtain an optimal portfolio for CE business model.
- Appling the MCDM method and consider the resource limitation.

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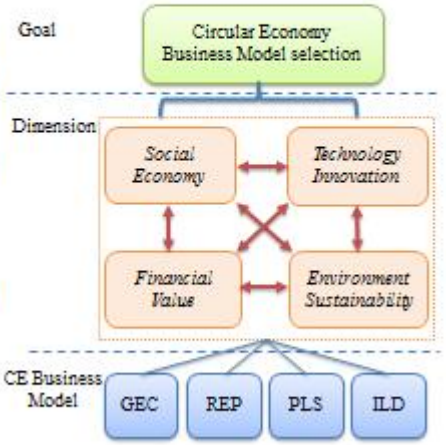
II.LITERATURE REVIEW

This section presents the CEE business model strategy evaluation criteria as derived from the literature, four main perspectives:

1. Social Economy (SE)
2. Technology Innovation (TI)
3. Financial Value (FV)
4. Environmental Sustainability (ES)



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Social Economy (SE)

Green Supply Chain (GSC)

Interdisciplinary Talents Cultivation (ITC)

Extended Producer Responsibility (EPR)

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Technology Innovation (TI)

- Innovative Industrial Symbiosis (IIS)
- Business Partner Cooperation (BPC)
- Green Innovation Technology (GIT)

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Financial Value (FV)

- Green Financial Policy (GFP)
- Financial Profitability Stability (FPS)
- Life-cycle Cost Monitoring (LCM)

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Environmental Sustainability (ES)

- Arterial-Venous Industry (AVI)
- Environment Ecology Symbiosis (EES)
- Carbon Footprint Verification (CFV)

CO2 Carbon Footprint Taiwan EPA

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III.METHODOLOGY

- **DEMATEL**: • Illustrating inter-relationships of criteria concerns and constructing network relationships.
- **ANP**: • Analyze the pairwise comparisons with criteria for a priority weight matrix.
- **Resource**: • Consider resource limitations in the decision process, focusing on budget amounts, consultant hours, training hours, and labor hours.
- **ZOGP**: • Focuses on the optimal objective achievement simultaneously to satisfy the various resource limitation conditions.

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CASE STUDY

Green Energy Industry Cluster (GEC)

The Platform of Recycling Exchange (REP)

Product Leasing Sharing Services (PLS)

Innovative Lightweight Designing (ILD)

Step 1: Evaluating Relationships among the Perspective

The relationship matrix of the perspectives for a CE business model selection ($p \geq 3.074$)

	SE	*TI*	*FV*	*ES*	D	D + R	D - R
SE	2.895	***3.369***	***3.375***	***3.121***	12.760	24.596	0.924
TI	***3.187***	***3.183***	***3.456***	***3.198***	13.024	25.777	0.271
FV	2.928	***3.154***	2.910	2.886	11.878	24.653	(0.896)
ES	2.826	3.047	3.034	2.608	11.515	23.328	(0.299)
R	11.836	12.753	12.774	11.813			

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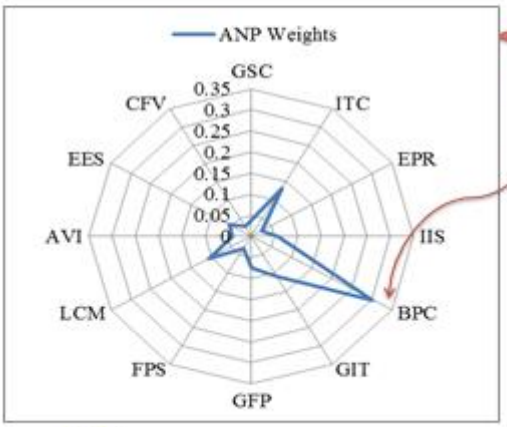
Step 2: Evaluating priority weight among the criteria



Business Partner Cooperation (BPC)

$$ANP_{CE} = \begin{bmatrix} GEC & = & 0.3601 \\ REP & = & 0.3008 \\ PLS & = & 0.1762 \\ ILD & = & 0.1629 \end{bmatrix}$$

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Step 3: Identify the resource requirement for CE business model

The resource requirements of the CE business model				
	Budget amounts (thousand dollars)	Consultant hours (h)	Training hours (h)	Labor hours (h)
	d_1	d_2	d_3	d_4
GEC	2500	700	1500	500
REP	2000	1000	1100	800
PLS	4500	800	1800	700
ILD	3500	1100	2000	500
Goal(bi)	10000	2800	4800	1800

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Step 4: ZOGP model

The main results are shown as follows:

GEC=1, REP=1, PLS=0, ILD=1, $d_1^- = 2000, d_1^+ = 0, d_2^- = 0, d_2^+ = 0, d_3^- = 200, d_3^+ = 0, d_4^- = 0, d_4^+ = 0,$

Green Energy Industry Cluster (GEC) + *The Platform of Recycling Exchange (REP)* + *Innovative Lightweight Designing (ILD)*

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CONCLUSION

- Taiwan aims to introduce renewable energy innovation policies to reach a cumulative installed capacity goal for the PV industry.
- For circular economy sustainability, green energy suppliers require changes throughout green value chains, need to consider PV product life cycle process improvement, and utilize business model innovation strategies to create maximize green economic values.

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CONCLUSION

- the significant factors Business Partner Cooperation (BPC) and Interdisciplinary Talents Cultivation (ITC), indicates that BPC can act as catalysts for circular economy development, and should take interdisciplinary talents cultivation into consideration to promote the future benefits of business model innovative strategies.
- The extended producer responsibility is ranked last. The results indicate that government needs to establish a circular economy operation mechanism for the PV industry to strengthen the awareness of environmental protection and sustainable economy to PV producers

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CONCLUSION

- The optimal portfolio strategies of the CE business model are the green energy industry cluster, the platform of recycling exchange, and innovative lightweight designing. Under the input resource limitation, the portfolio emphasizes the green energy technology cluster development to effectively strengthen the platform of waste-to-resource exchanges.

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