出國報告(出國類別：其他)

參加「第 25 屆智慧運輸世界大會」報告書

服務機關：中華郵政股份有限公司

姓名職稱：魏健宏　董事長

派赴國家/地區：丹麥

出國期間：107 年 09 月 16 日至 23 日

報告日期：107 年 10 月 22 日

系統識別號：C10702617

行政院及所屬各機關出國報告提要

出國報告名稱：參加「第 25 屆智慧運輸世界大會」報告書

頁數 34 頁 含附件：■ 無 □ 有

出國計畫主辦機關：中華郵政股份有限公司

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出國類別：□1.考察□2.進修□3.研究□4.實習□5.視察□6 訪問

□7.開會□8.談判■9.其他

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內容摘要：

智慧運輸世界大會(Intelligent Transport Systems World Congress, ITSWC)係全球三大洲輪流主辦的交通運輸科技專業會議，不僅政府單位非常重視，也吸引資通訊產業大廠積極投入。中華郵政公司補助報告人前往丹麥哥本哈哥市(Copenhagen, Denmark)參加「第 25 屆智慧運輸世界大會」(25th Intelligent Transport Systems World Congress, ITSWC)，會議日期為 2018 年 9 月 17~21 日。本年度世界大會由 ERTICO (ITS-Europe)擔任主辦單位，City of Copenhagen、ITS-Denmark 共同承辦，另由 ITS-Asia-Pacific、ITS-America 等機構配合辦理各國政府官員、學者、業界專家之推薦與聯繫等。主辦單位在會後總結報告公布，本年度總計有 90 餘國、約 1 萬人參加大會相關活動。報告人主要參與項目包含發表 1 篇研究論文、參加技術參訪、參觀展示攤位、國際交流等。本報告書概述參加會議經過、觀摩心得、並提出數項建議，可供中華郵政公司參採。

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一、 出國目的

經由中華郵政公司之補助，報告人得以前往丹麥哥本哈哥市(Copenhagen, Denmark)參加「第 25 屆智慧運輸世界大會」(25th Intelligent Transport Systems World Congress, ITSWC) ，會議日期為 2018 年 9 月 17~21 日。報告人主要參與項目包含發表 1 篇研究論文（如附錄 1 所示）、參加技術參訪、參觀展示攤位、國際交流等，大會議程、場次安排內容、展場攤位與活動區位平面圖等，詳如附錄 2 所示。

二、 會議概述過程

「第 25 屆智慧運輸世界大會」(25th Intelligent Transport Systems World Congress, ITSWC)，會議日期為 2018 年 9 月 17~21 日。大會主場地 Bella Center 是北歐地區最大型國際會展中心，位於哥本哈哥市東南區，建築設計很有特色，並且在造景設計上巧妙地展示丹麥非常注重環保、善用清潔能源、高階風力發電技術等特色（圖 1-4）。

本年度世界大會由 ERTICO (ITS-Europe)擔任主辦單位，City of Copenhagen、ITS-Denmark 共同承辦，另由 ITS-Asia-Pacific、ITS-America 等機構配合辦理各國政府官員、學者、業界專家之推薦與聯繫等。主辦單位在會後總結報告公布，本年度總計有 90 餘國、約 1 萬人參加大會相關活動。

圖 1

圖 2

圖 3

圖 4

本年度大會主題為「智慧運輸帶來高品質生活」(ITS- Quality of Life)，此係由於哥本哈根市目標訂於 2025 年成為全世界第一個「碳中和城市」(carbon-neutral city)，此項極具難度的目標必須借助智慧運輸的技術與方案，以確保在高強度的節能減碳運作機制下，都市發展所需要的交通運輸功能不會衰減。哥本哈根市充分把握此得來不易的地主城市契機，在全球各地來訪的賓客面前，驕傲地展示多項成果、進行中的計畫、持續研發的創意構想等。

在議程方面，共分為 6 大類：

1. 開幕、閉幕典禮（Opening & Closing Ceremony）

主辦單位精心設計富有當地文化特色之表演節目，穿插於儀式項目進行之中，深致歡迎之意，亦傳承接續於來年之主辦國。

2. 研討場次（Sessions）

- 大會場次（Plenary Sessions）

邀請政府與業界重量級人士針對本屆大會主題與推動政策提出專精看法，共 3 場。本年度規劃重點聚焦於發展智慧運輸成為開放平台，運用於未來日常生活中，以符合環保、節能、永續等新世代挑戰，且兼顧經濟成長之目標。

- 執行場次（Executive Sessions）

由高階產業界執行長、政府官員與資深學者發表其自身經驗及專業見解，共 12 場。

- 特別場次（Special Interest Sessions）

邀請開發及建置 ITS 系統之專家暢談研發及落實 ITS 所面對之挑戰，規劃為公開論壇與工作坊之形式，共 90 場。

- 科技論文發表場次（Scientific and Technical Sessions）

這是大會重頭戲之一，約 500 份專題研究成果在此發表，共 90 場。

- 產業論文發表場次（Commercial Paper Sessions）

產業界新近開發完成或改善之後的產品、設備與創新理念等，對於智慧運輸服務市場的發展有直接密切的關聯性，大會乃於展覽場安排專區給產業界人士展示（不同於展覽場攤位的表達方式），總計 30 篇報告。

- 躍出框架場次（“Out of the Box” Sessions）

大會特別在展覽場安排 ITS Forum（智慧運輸論壇）專區，營造不同於科技論文發表場次較為嚴肅拘謹的環境、促進發表人與觀眾更直接且多面向的互動，這是本次大會的創舉之一。

3. 展覽（Exhibition）

參展者來自世界各地之產、官、學、研各界，包含各種研發理念、實測系統、ITS 核心產品、關連產業、政府與運輸單位建設成果等，共有 370 家廠商與政府機構參展。

4. 技術參觀（Technical Visits）

主辦單位安排 17 項行程可供選擇，參訪哥本哈根市及鄰近地區交通設施、ITS 科技研發成果與先導測試專案等，內容計有交管中心、交通資訊中心、橋梁/隧道監控中心、智慧住宅、智慧城市、自行車系統、海港與空港等。

5. 技術展示(Showcase Demonstrations)

大會設計 9 項技術展示，在研討會會場附近道路設置實物展示(Demo)，將多個 ITS 技術及設備串連在一起形成一個智慧服務路網，可提供來參與之專家學者體驗及指教。內容除了持續關心的交通安全與管理、永續運輸、個人化服務等，因應自駕車潮流與地主國自行車的重要地位等，亦有廠商提出創意服務與大會主題相呼應。

6. 社交活動（Social Events）

大會安排歡迎酒會與大會正式晚宴（收費）提供交誼機會。

三、 開幕典禮

9 月 17 日下午舉行大會開幕式，歐盟運輸部長(European Commissioner for Transport) Violeta Bulc 女士、哥本哈根市長(Lord Mayor of Copenhagen) Frank Jensen 先生、科技與環境事務副市長(Mayor of Technical and Environmental Affairs in Copenhagen) Ninna Hedeager Olsen 女士等，分別上台致詞歡迎來自世界各國的代表團，並且清楚陳述智慧運輸在歐洲都市、歐盟國家、歐盟區域發展的關鍵性地位，三大洲智慧運輸聯盟(ERTICO - ITS Europe, ITS America and ITS Asia-Pacific)執行長（秘書長）亦分別登台陳述智慧運輸在各區域日益受到重視的價值。更令人興奮的是丹麥王儲 Frederik André Henrik Christian (HRH the Crown Prince of Denmark)親臨大會發表演說，強調丹麥對於智慧運輸的重視與期待（圖 5、6）。

圖 5

圖 6

開幕典禮的重要內容包含頒贈「世界大會終身成就獎，Hall of Fame of World Congress on ITS」，亞太地區推薦的世界大會終身成就獎係由我國交通部政務次長王國材博士獲得，這是繼 2013 年第 20 屆智慧運輸世界大會頒贈終身成就獎給時任行政院副院長毛治國博士，我國第二度獲此殊榮。在亞太地區，我國從未獲得世界大會主辦權（澳洲、日本與韓國各自主辦兩次世界大會），卻能夠在此世界大會殿堂再度獲得肯定，實在是令人感到非常興奮與驕傲。尤其是王政次先前擔任中華郵政公司代理董事長將近一年，在大部繁重政務之中，仍須兼顧中華郵政公司的重要事務督導與推進，基於此一層特殊關係，報告人更是感到在大會現場親身觀禮的寶貴價值。我國派駐丹麥代表處莊恒盛代表（大使）也到場觀禮並表達祝賀（圖 7）。頒獎典禮之後，台灣代表團成員齊聚大會舞台合影，為我國與王政次在國際場合的發光發亮而歡呼。大家隨後進入展覽場、來到台灣館，再度與王政次合影，所有人都要與 ITS-Taiwan 更緊密結合（圖 8-11）。

圖 7：前排(右)王國材政次，前排(左)莊恒盛大使，後排(右)ITS-Taiwan 理事長張永昌博士，後排(中)財團法人中華顧問工程司吳盟分董事長，後排(左)報告人。

圖 8

圖 9

圖 10

圖 11

四、 展覽參觀與心得

展覽場安排與台灣的交通運輸或科技專業年會並無顯著的不同，但有幾項是報告人覺得非常貼心且能夠讓與會人更融入這場活動的：

1. 會場入口處有免費提供「Dailynews」的書刊，將昨日在研討會所發生的談話或事件整理至裡面，可以讓與會者更投入於研討會中，或能補齊遺漏的資訊。

2. 提供專屬於研討會的 APP，與會者透過手機下載即可方便且明瞭地查詢任何資訊及場次時間（圖 12、13）。

3. 備有相當多令人休息的地方，可能場地夠完整是其中原因，也有專門為簡報者提供的準備區，處處都可以看到茶水區與管制人員，感受的到主辦單位相當重視每一個環節。

4. 將累積 25 屆(1994~2018)的世界大會主視覺圖案在會場人流主要動線處匯集展示（圖 14-18），無論資深人員或後進新秀都會有特殊的感受，來自曾經主辦的國家（城市），不免油然而生光榮感。報告人細數之後，驚覺已經參加超過一半的世界大會（總計參加 13 屆），沒有重複主辦城市的案例，顯示智慧運輸是全球主要都市共同的努力方向。

參展廠商在現場爭奇鬥豔，無不拿出最佳產品與創新設計，吸引參觀人潮與商機。報告人特別被一組電動物流自行車吸引，車體造型、功能設計、環保概念等，都有獨到之處（圖 19-22）。還有許多互動的展示儀器皆可以免費嘗試，此外，另一個吸引報告人目光的是個人化電動車（圖 23、24），該產品非僅限於代步交通，能手提至任何地方或做為手拉車，駕駛起來如同行駛機車，前方有感應裝置，如遇上障礙物會自動停駛避免撞上。

展覽場現場相當的遼闊與豐富，且有很多都與「駕駛人」或「無人駕駛」有關的儀器，可見如何提升駕駛安全、提供交通服務已是全世界所關心的議題。傳統手機大廠 Nokia 有一句著名的廣告標語「科技始終來自於人性」，現在依然深入人心，似乎蘋果手機更能掌握人性科技，且理解使用者的需求，短短數年風靡全球、造就驚人的市場價值。因此田野實際觀察與感受變得更為重要，想知道什麼資訊，有什麼需求應被滿足，不應該一味地從供應者的技術角度出發，在展覽場是最直接可以知道設計者所欲解決的問題。


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圖 12

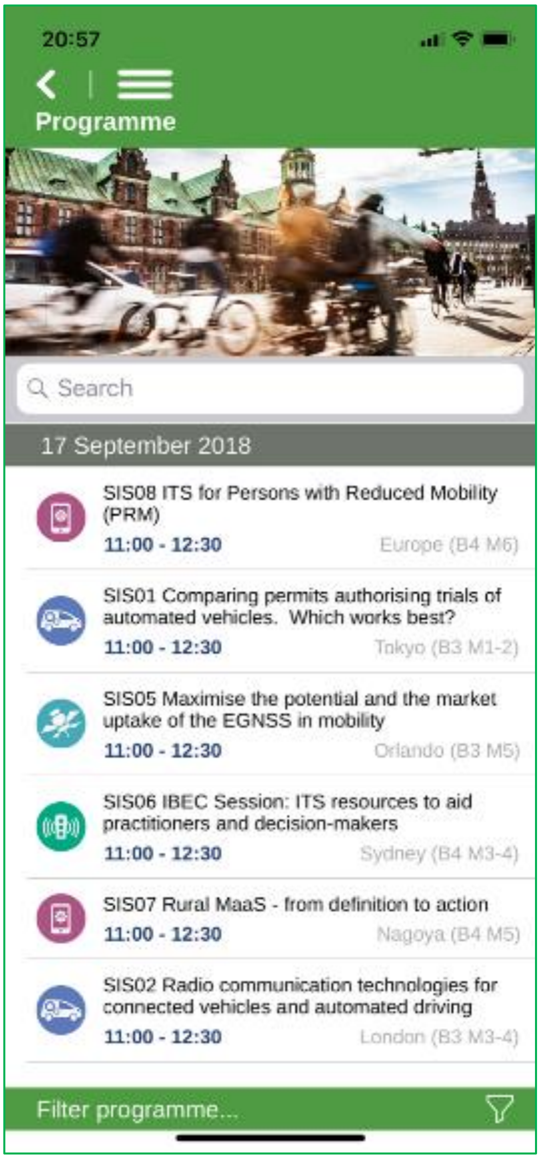
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圖 14

圖 15

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圖 20

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圖 23

圖 24

五、 論文發表

大會的科技論文議程、展示內容、專家演講、高階官員圓桌會議等，係經由國際議程委員會討論設定為六項主軸議題，符合當今全球化趨勢、重視環保、資通訊科技迅速發展等特性。主辦國基於北歐地區跨國境之交通運輸非常頻繁，歐盟會員國之間亦是如此，必須相互溝通謀求有效的方案，因此增加第七項主軸議題。報告人觀察到物流(goods delivery)被單獨設定為主軸議題之一，顯示其被全世界關注之重要性，報告人亦聯想起中華郵政公司積極發展智慧物流服務體系，確實與世界緊密接軌。

1. Mobility services - from transport to mobility to livability

2. ITS and the environment

3. Connected, cooperative and automated transport

4. Next generation goods delivery

5. Satellite technology applied to mobility

6. Transport network operations

7. Cross-border mobility solutions

報告人發表之論文 Application of ANN Models to Simulate Personalities Causing Aberrant Driving Behavior and Construct the Driving Risk Level for Inter-City Bus Drivers，中文名稱「運用類神經網路模擬人格特質所造成之偏差駕駛行為與建構駕駛風險分級體制-以國道客運駕駛員為例」，詳見附錄 1。本論文之研究緣起係基於國道客運為臺灣地區主要之中長途城際運輸服務之一，在肇生交通事故時，往往因大客車載客容量特性而造成大量的人員傷亡。歷年官方統計數據皆指出，90%以上之交通事故主因係人為所致，故駕駛員的駕駛行為係影響整體行車安全性之重要因子；而駕駛員品質不僅直接影響國道運輸安全，更為影響客運公司營運績效之關鍵。近年來，國道客運服務品質逐漸受到重視，駕駛員之駕駛行為亦被列為國道客運評鑑項目之一，顯見駕駛行為對國道運輸品質影響之重要性。無論從學理論述或經營管理者經驗分享，客運駕駛員之駕駛行為受到自身人格特質一定程度之影響，為確保乘客人身安全及提升客運業者營運安全績效，實有建構人格特質影響偏差駕駛行為與駕駛風險模式之必要。本研究透過個案客運公司提供行車紀錄器資料、辨認可能導致交通事故風險之偏差駕駛行為，並就整體駕駛風險加以分級，以衡量個別駕駛員整體駕駛風險性高低；另藉由個案公司協助問卷發放取得駕駛個人資料，了解人格特質與駕駛風險之間的關聯性。本研究以偏差駕駛行為為基礎，評估駕駛員風險值、建立駕駛風險分級制度，並分別建構模型檢驗人格特質對國道客運駕駛員之偏差駕駛行為特性與風險分級結果之影響。本論文的研究發現符合統計檢定顯著性之門檻值，顯示具有客觀性與合理性，此模型後續得以進一步推展成為既有駕駛員安全風險管理與適任性評估，同時亦憑以作為新進駕駛員聘任的參考指標之一。

基於此論文之過程經驗與合理結果，未來此研究方法可以推廣至物流運輸系統之管理面。在標準化物流體系中，貨運車輛的動態監控平台是必備的基本設施（功能），但是，現有的車隊監控系統多數僅止於車輛即時位置與歷史路線軌跡，駕駛員的操作車輛行為需要數位式行車記錄器（類似飛機的黑盒子）執行即時、不間斷的紀錄與儲存，必要時以無線通訊模組傳送回監控中心，此種數位式偵測、紀錄、無線傳輸機制乃形成智慧物流的重要特徵。財務投資往往是智慧物流發展的重大瓶頸之一，以致於物流業者能晉升智慧物流者實不多見，以致於物流產業的質能進步緩慢。中華郵政公司實為全國最大規模的物流企業體、又是國營體制，在經費籌措面並非困窘；進一步言，每天有將近一萬名同仁（車輛）在全國各地道路網疏運、遞送信函與包裹，其交通曝光量換算之風險值實在非常驚人，任何能夠降低物流營運風險的機制都必須積極追求到位。簡言之，轉型朝向智慧物流體系推進，必然是中華郵政公司在楬櫫數位轉型策略之際，必須優先推行實踐的範疇。如何規劃出符合成本效益的實施方案，不啻為經理部門重中之重任務。

此論文的另一個關鍵特色，「駕駛員人格特質與駕駛風險之間的關聯性」是學術文獻與實務領域尚不多見的研究成果，也是可以水到渠成引介至中華郵政公司的智慧物流體系，使其功能更加超越多數專家的期盼。大多數物流（貨運）公司駕駛員的管理制度較為鬆散，駕駛員人格特質的基本資料不易搜集彙整，然而，中華郵政公司管理制度健全、各級主管與駕駛員日常互動密切，實施人格特質調查（問卷或面談）的成功性頗高。因此，開發專屬適合於中華郵政公司的駕駛員風險評估模式之可行性相當高。若為建立主動預防風險機制，必要做法是將此模型納入新進駕駛員（郵務人員）招考聘任的程序內，篩除潛在高風險者（駕駛適任性不通過中華郵政公司的門檻）。在現有員工的交通安全管理層面，可以綜合考量前述操作車輛行為特性、個人人格特質等，客觀審定個人交通風險參考值，以個別通知方式提醒員工多加留意，也適用於各級主管日常之員工關懷、提升差異化職能培訓的效果。

綜合而言，智慧物流系統功效之達成，必須在交通安全獲得有效確保的前提，始有營運績效提升之成就。改善交通安全是需要高階管理者有清楚認知與具體承諾，才能夠投入適當經費與設備、長期持續蒐集完整資料（人員、車輛）、分析資料、建立中華郵政公司駕駛員風險評估模式、鉤稽現有營運管理體系與在職訓練計畫，逐步改善現有在職人員（駕駛員）的交通風險。進而在招募制度中增加交通風險預防機制，篩選交通風險較低者成為中華郵政公司工作夥伴，營造安全健康的良好工作環境。

六、 技術參訪

DOLL Lab 係歐洲最大的測試場、展示區、創新基地、聚焦於智慧城市與智慧照明應用，其全名為 Danish Outdoor Lighting Laboratory (DOLL)，該場域面積約 1.5 平方公里，乃為正常使用中的工業區，常態性工作人口約 1 萬人。基於追求清潔能源之國家目標，在此區域設置實際運轉的真實生活環境實驗室(Living Laboratory)，俾以測試智慧連網城市(Smart and connected cities)的諸般課題。

此場域邀請科技廠商、新創團隊、哥本哈根市鄰近都市、研發機構、大學等成為策略性夥伴，提供空間及開放式平台給予照明設備廠商進行測試，例如智慧照明監控系統與車輛偵測器之整合，未有車輛出現之處，無須發出照明，可能達到節能減碳效果。

自 2014 年啟用以來，DOLL Lab 已經結合 40 餘個國內外企業在此場域測試或展示最新的智慧照明方案。例如某處戶外停車場照明的燈具樣式與太陽能板電源，同時裝置數套不同型式，即可在相同環境背景下，評估較佳之型式（圖 25）。亦有某處燈桿連接了聲響偵測器（圖 26），將分貝值轉換為控制 LED 燈色的指令，在夜間的喧嘩聲將使路燈光色由溫暖的燈泡色轉變為刺眼明亮的白色光，噪音製造者將無所遁形，引導民眾自我控制行為。

DOLL Lab 近期的亮點是區內設置了全世界第一座 5G 無線通訊基地台，整合於路燈桿，解決了 3G/4G 基地台建設之難題，而且使用太陽能板作為電力供應(圖 27、28)。

圖 25

圖 26

圖 27

圖 28

中華郵政公司應該可以參考 DOLL Lab 的營運理念，在郵政與儲匯業務不致受到明顯干擾的前提下，開放正常營運的場域（局屋設施監控、營業廳、服務櫃台、郵遞車輛與郵務士等），結合學術界、法人機構、科技廠商等，進行符合彼此共同效益的現地測試，只要構思一套合法有效的程序，必然可以獲得我司績效提升的方案，亦可協助其他機構的目標達成，此允為國營企業回饋社會的有效途徑。

七、 閉幕典禮

大會閉幕典禮並非行禮如儀、邀請幾位貴賓致詞，籌備委員會有適度分工、彙整數日以來眾多場次高階官員、技術專家與企業主管的討論內涵，現場公布大會七大主軸議題的結論，無論是達成具體共識或仍有待再探討的議題，使得與會人員得以體認世界主流趨勢、繼續往前推進（圖 29、30）。

智慧運輸世界大會的優良傳統之一是在閉幕典禮舉行「接棒傳承儀式(Passing the Globe Ceremony)」，然後由下一屆主辦城市的代表致詞邀請大家明年度再相會，2019 年主辦城市為新加坡，照例製作三分鐘短片呈現新加坡的好客熱情、科技發展、智慧運輸特色等（圖 31、32）。

圖 29

圖 30

圖 31

圖 32

八、 結語與建議

台灣與會者近 70 人參與盛會，包含大學教授與學生、專業顧問機構主管、科技公司高階經理人、廠商業務主管、政府機關與法人研究機構代表等。國內學者專家除了發表論文，也擔任技術論文場次主持人，另有數位受邀在執行場次或特別場次專題報告台灣地區之公私部門經驗及課題，使得世界各國夥伴仍有機會了解 ITS 在不同地區、文化背景等狀況下之實質演進。

回頭看台灣內部，雖然大環境與國際形勢相對不利，但是有關於 ITS 之基礎研究與多種規模建置試辦計畫都有相當明確之成果，而且絕不遜於國際廠商在世界大會展場之亮麗看板，為什麼仍然不能讓一般民眾感到交通運輸服務與環境之進步，大家對於日常生活仍多所抱怨？最重要的關鍵應該在於中央政府並未真正重視 ITS，最高民意機關(立法院)也未能體察世界重要潮流之演進，在全世界大多數國家皆已確認 ITS 之必需性而且以跨部會之力量結合民間能量全力發展 ITS 智慧服務之際，報告人之政府單位仍僅偏重於新設施建設案，極端強調以工程建設手段來服務民眾。事實上，以台灣的現有交通運輸設施數量、分布密度、應有的服務水準等來評比，都可列在全球領先的層級，反而是效率性、安全性、環保性、永續性等議題被長期忽略，這些議題實為 ITS 所特別強調注重的具體效益。將有效的策略性方向擺在一旁，卻繼續製造問題，這就是台灣交通問題癥結所在。

據研究顯示，地球上大約有 28%溫室氣體是來自於交通運輸的排放上，近年舉辦之 ITS 世界會議展望就是要發展一個安全、有效率及低排放量的交通世界。歷屆 ITS 世界會議主辦國皆為工業先進國家，無論科技與經濟能力皆為世界領先族群，因此充分利用大會期間展示其科技實力與具體成果，達到非常顯著的國際宣傳及經貿行銷之效果。台灣在這場世界性競爭中，目前僅能爭取在亞太地區內的角色（2011 年第二度主辦 ITS 亞太論壇會議），反觀日本已主辦第 2 屆、第 11 屆、第 20 屆；韓國已主辦第 5 屆與 17 屆世界大會；中國主辦第 14 屆大會；澳洲已主辦第 8 屆、第 23 屆。明確地顯示先進國家已逐漸具體地將交通運輸系統智慧化之成

果向前推展，並且在穩定成長之經濟宏圖中扮演重要支柱角色。我國(ITS-Taiwan)曾經結合台北市政府共同爭取 2019 年、2022 年主辦權，但是都沒有成功，現今正努力凝聚更多力量、以 2025 年主辦權為目標。如果爭取成功，報告人屆時都是退休人士了，培育年輕人接棒傳承是必須的。

交通安全改善計畫的財務投資往往是智慧物流發展的重大瓶頸之一，以致於物流業者能真正晉升智慧物流者實不多見，無怪乎物流產業的質能進步緩慢。中華郵政公司為全國最大規模的物流企業體、又是國營體制，在經費籌措面並非困窘；進一步言，每天有將近一萬名同仁（車輛）在全國各地道路網疏運、遞送信函與包裹，其交通曝光量換算之風險值實在非常驚人，任何能夠降低物流營運風險的機制都必須積極追求到位。簡言之，轉型朝向智慧物流體系推進，必然是中華郵政公司在榻櫫數位轉型策略之際，必須優先推行實踐的範疇，其中的交通安全環節更是關鍵項目，如何規劃出符合成本效益的實施方案，不啻為經理部門重中之重任務。報告人於此論文之過程經驗與合理結果，未來此研究方法可以推廣至物流運輸系統之管理面，建立中華郵政公司駕駛員風險評估模式、鉤稽現有營運管理體系與在職訓練計畫，逐步改善現有在職人員（駕駛員）的交通風險。進而在招募制度中增加交通風險預防機制，篩選交通風險較低者成為中華郵政公司工作夥伴，營造安全健康的良好工作環境。

附錄 1 發表論文

Paper ID AP-TP1246

Application of ANN Models to Simulate Personalities Causing Aberrant Driving Behavior and Construct the Driving Risk Level for Inter-City Bus Drivers#

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Abstract

As the growing trend of inter-city travel demand featuring high-capacity vehicles is linked with serious casualties, inter-city bus safety is considered a significant and urgent issue. In contrast to previous studies, this study focus on the effect of individual driver's personalities; an equitable mechanism to forecast driving behavior could be used to prevent human-caused accidents. This study collected the personality information of 62 e-bus driver's and detected a driver's aberrant driving behavior by electronic tachograph. Personalities were divided into the Big Five personality dimensions, and nine types of recorded aberrant driving behavior were simplified into six types. We next applied artificial neural network (ANN) models to simulate driving behavior, thus reflecting the frequency of aberrant driving behavior for each driver. Then, we constructed a risk level evaluation mechanism based on aberrant driving behavior. The proposed model could pre-classify a driver's risk level and provide incentive mechanisms and new recruitment criteria for bus carriers.

Keywords: artificial neural network, driving risk level, personalities

1. Introduction

Inter-city buses have become a popular and common transportation mode in Taiwan since they are cheaper than most long-distance travel options. However, as inter-city buses do not have exclusive lanes, driving with multiple traffic flows might dramatically increase accident frequency. In addition, high capacity vehicles could increase the chance of there being serious casualties in an accident.

Inter-city bus carriers consider inter-city bus safety a significant and urgent issue. Currently, inter-city bus carriers use an inspection system to improve the hardware facilities and detect a bus driver's mental status. While recent policy documents evaluate driving behaviors, they mainly focus on the relationship between driving behavior and fuel consumption. However, we consider it essential to pay attention to the effect of driving behavior on driving safety.

Drivers' behaviors are strongly related to road safety and incident rates, and they thus influence a carrier's reputation. As driving performance could be affected by personality, various compositions of personality traits could lead to different decisions being made. To enhance highway safety and reduce potential risk, we aim to comprehend the relationship between a driver's behavior and their personality. An evaluation mechanism should be made integral to the carrier's processes to assess driving performance. This study transforms aberrant driving behaviors into driving risk and constructs an evaluation mechanism based on the different levels of driving risk. One purpose of this research is to simulate the extent of each aberrant driving behavior so that the driver can be alerted and a bonus system promoting improvement can be established. Further, constructing an evaluation mechanism could classify bus drivers into different clusters to design risk management.

2. Materials and Methods

Big Five personality

Costa and McCrae (1989) characterized human personality by the Big Five personality traits: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. This model has become the most accepted personality measurement in the literature.

Data collection and pre-processing

This study collected personality data from 62 bus drivers using a questionnaire (Chen, 2013), and gathered aberrant driving behavior data by setting up on-board units (OBU) on each bus. Initially, nine aberrant driving behaviors were recorded by the bus company: shift to right, shift to left, not keeping a safe distance, severely not keeping a safe distance, exorbitant revolutions per minute, exceeding the speed limit, hard acceleration, overusing the electromagnetic brake, and idling for too long. To enhance the artificial neural network (ANN) performance, we analyzed the correlation coefficient between each driving behavior and integrated behaviors with strong acceleration. "Shift to right" and "shift to left" were merged into "land shifting," and "severely not keeping a safe distance" was incorporated into "not keeping a safe distance." "Idling for too long" was deleted because it seemed to have less influence on driving safety and was more closely related to driving efficiency and environment.

The recorded numbers of aberrant driving behaviors among each driver were widely distributed. We utilized min–max normalization to transform aberrant driving behavior into risk value. We normalized the dataset normalized using equation (1) to define a risk value between 0 and 1. Thus, the risk associated with a driver's aberrant driving behavior is measured by the relative danger of each driver's frequency of aberrant driving behavior. Equation (2) sums the individual driving risk values to present the overall driving risk for a driver. After consolidating and transforming the raw data, an evaluation of each driver's risk may be conducted effectively.

$$r_i^j = \frac{f_i^j - f_{min}^j}{f_{max}^j - f_{min}^j} \tag{1}$$

$$R_i = \sum_{j=1}^{n} r_i^j \tag{2}$$

where

r_i^j is the risk value of driving behavior j for driver i,
f_i^j is the number of times of driving behavior j for driver i,
f_{max}^j is the maximum number of times of driving behavior j,
f_{min}^j is the minimum number of times of driving behavior j, and
R_i is the overall risk value for driver i.

ANN

The ANN is a computational model that imitates the structure and features of a biological neural network. "A neural network is a massively parallel distributed processor made up of simple processing units, which have a natural propensity for storing experimental knowledge and making it available for use" (Haykin, 2001). The neural network model applied in this study is multilayer perceptron (MLP), which is a classical learning rule for training networks, being a feedforward network that is widely and frequently used for classification, prediction, and optimization (Golden et al., 1997).

The operational links between two layers are the weight coefficients. Using training samples, the weight coefficients can be optimized. The input variables are multiplied by the weight coefficients, and the products are summed as a phased value. The activation functions are mathematical functions used to transform the sum into an output value. Figure 1 displays the function of the neuron between two layers. The output value will be within a certain range.

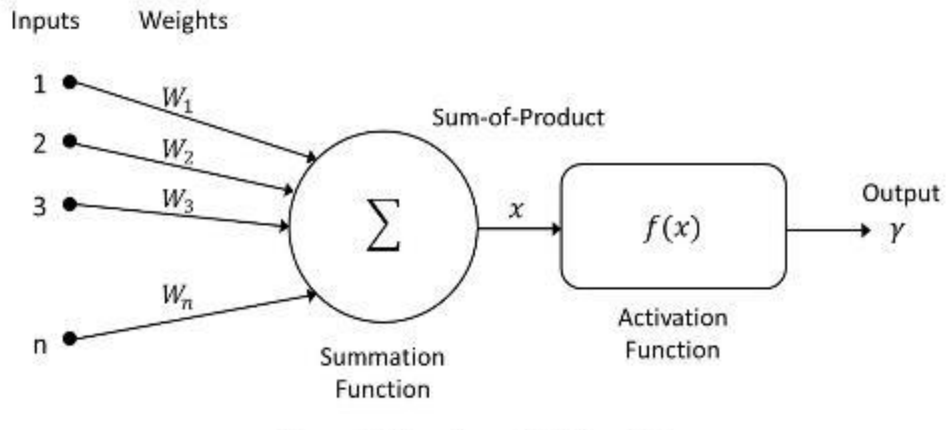


Figure 1. Function of ANN model.

The back propagation (BP) algorithm is usually used to calculate the error contribution of each neuron after a batch of data is processed. During training, the error between the actual and output is calculated, and the corrected algorithm is sent back to the previous layer. Weight coefficients are corrected, and the training periods restart until the error reaches the minimum and before the error starts to increase again. The final weight coefficients should provide relatively accurate output.

3. Research Structure

Figure 2 shows the overall structure of this research.

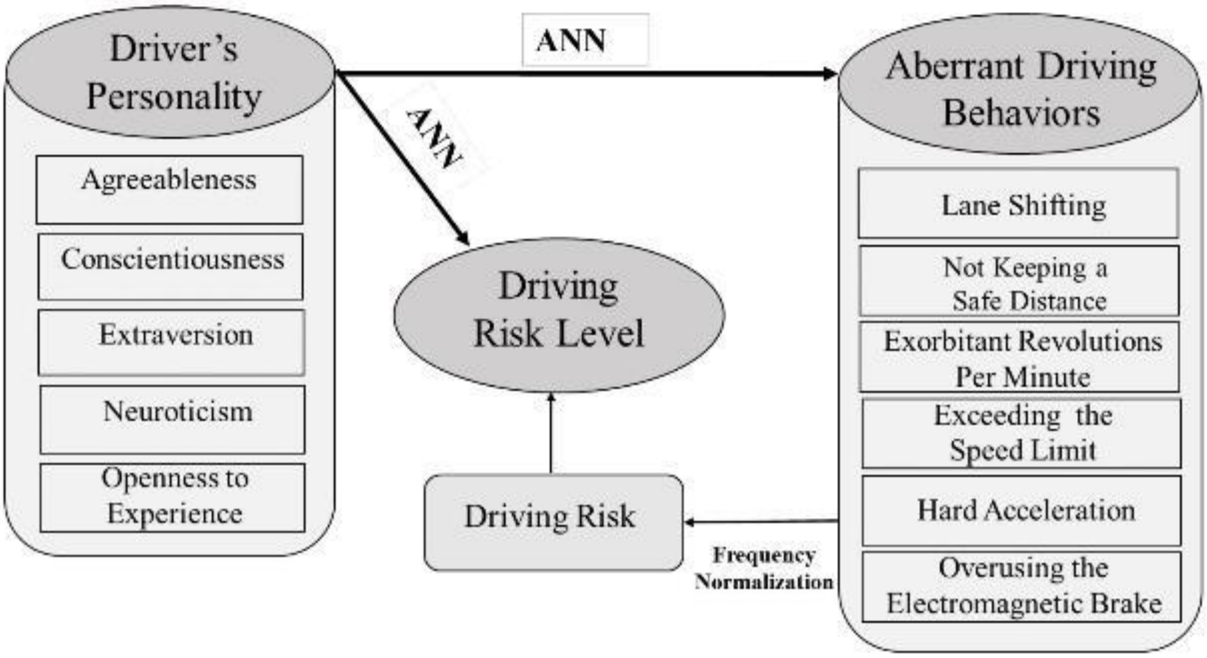


Figure 2. Research structure.

Simulation of Aberrant Driving behaviors

Application of the ANN model could simulate the risk value of driver-made aberrant driving behaviors. Each Big Five personality trait might influence each aberrant driving behavior differently. Additionally, different from the individual risk value of a specific aberrant driving behavior, the overall driving risk of a driver is assessed by comparing the sum of the driver's risk values based on each aberrant driving behavior. The ANN structure is trained by setting the five personality traits as the input variables and a driver's individual driving risk value as the output variable.

Constructing Driving Risk Level

So that the dataset can be manipulated and be discriminated, we normalize the frequency data between 0 and 1 for each type of aberrant driving behavior. Then, we use the normalized and overall driving risk value to construct the driving risk level. Two grading rules are used, the fixed interval grading rule and the fixed percentage grading rule. The fixed interval grading rule divides the range between maximum value and minimum value into five-equal columns, and the 62 drivers can be classified into the above five levels. The fixed percentage grading rule divides the 62 drivers into 10%, 20%, 40%, 20%, and 10% (Naito et al., 2009). For management efficiency, the driving risk levels are summarized as five categories (level 1 = very low risk to level 5 = very high risk). Drivers classified at a higher risk level should be warned, and drivers classified at lower risk levels should be rewarded. Therefore, the level can be considered a holistic indicator.

Predicting Driving Risk Level

Apart from simulating the risk value of each aberrant driving behavior, this study applies the ANN model to predict the risk level of each bus driver. To infer how personality impacts driving risk level, the model sets the five personality traits as the input variables and sets the risk level (from one to five) as the output variable. Thus, the combination of the five personality traits can be used to obtain the driver risk level without gathering aberrant driving behavior data for the driver. The bus carrier could pre-classify the risk level of each driver by surveying the driver's personality. In other words, an efficient recruitment criterion based on this work could avoid recruiting high-risk drivers.

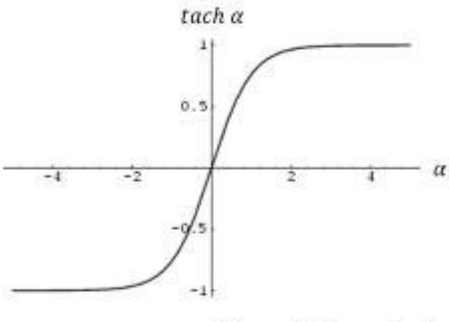
4. Result

ANN topology selection and rule

The analysis software STATISTICA 13 was used to run the ANN models and training data. The structure of the ANN models was optimized using the training dataset with the BP algorithm. The drivers' dataset was divided into 80% for the training set and 20% for the testing set. That is, the network trained on 50 random data and the other 12 data tested the performance of the ANN model.

The ANN topology plays a fundamental role in its functionality and performance. Fiesler and Beale (1996) defined the neural network topology as consisting of a neural framework and interconnection structure. To determine the final architecture of the ANN model, a (lengthy) process of trial and error is used to select the best performance from different networks with random initial weight coefficients. Then, the adopted architecture is the MLP model with one hidden layer. The topology of the six aberrant driving behaviors' performed well with different hidden nodes.

After the hidden layer was decided, the activation function "hyperbolic tangent" was used, as shown in Figure 3. The tangent is a sigmoid curve similar to the logistic function, and often performs better than the logistic function because of its symmetry. The output is contained in the range between 1 and -1.



$$\text{tach}\alpha = \frac{e^{\alpha} - e^{-\alpha}}{e^{\alpha} + e^{-\alpha}}$$

Figure 3. Hyperbolic tangent.

Simulation of Aberrant Driving Behaviors

The risk values of the six aberrant driving behaviors and overall driving risk values were used set as the targets (dependent variables), and the results from the investigation of the five personality traits were set as the input variables (explanatory variables). This study verified the efficacy of the ANN models by comparing them with the traditional multiple regression model. Table 1 shows the selected number of hidden nodes and testing results. In simulating the risk value of aberrant driving behaviors, the ANN models performed much better than the multiple regression models. The R-squared (R^2) and Mean square error (MSE) values were calculated to measure the performance of the prediction capacity. The closer R^2 is to 1, the greater the explanatory power shown by the model. The MSE shows the average of total deviations, and a value closer to zero represents less error.

Figure 4 illustrates the correlation between the actual target and the predicted output. The fitness curve (sequential line) represents the accurate prediction. In contrast to the multiple regression model, the 12 sets of data tested by the ANN model were closer to the fitness curve. In other words, the ANN model had high explanatory ability and less error.

Table 1. Testing results of models*

Aberrant Driving Behavior	Number of hidden nodes	Activation Function	ANN Model		Multiple Regression	
			Rsq.	MSE	Rsq.	MSE
Land Shifting	5	Tach	0.708	0.024	0.545	0.047
Not Keeping a Safe Distance	5	Tach	0.955	0.015	0.378	0.037
Exorbitant Revolutions Per Minute	5	Tach	0.373	0.075	0.007	0.086
Exceeding the Speed Limit	8	Tach	0.922	0.074	0.315	0.066
Hard Acceleration	7	Tach	0.850	0.004	0.093	0.007
Overusing the Electromagnetic Brake	8	Tach	0.940	0.019	0.744	0.035
Overall Risk Value	4	Tach	0.880	0.207	0.722	0.360

*Rsq. and MSE are calculated by the average value of 10 random networks

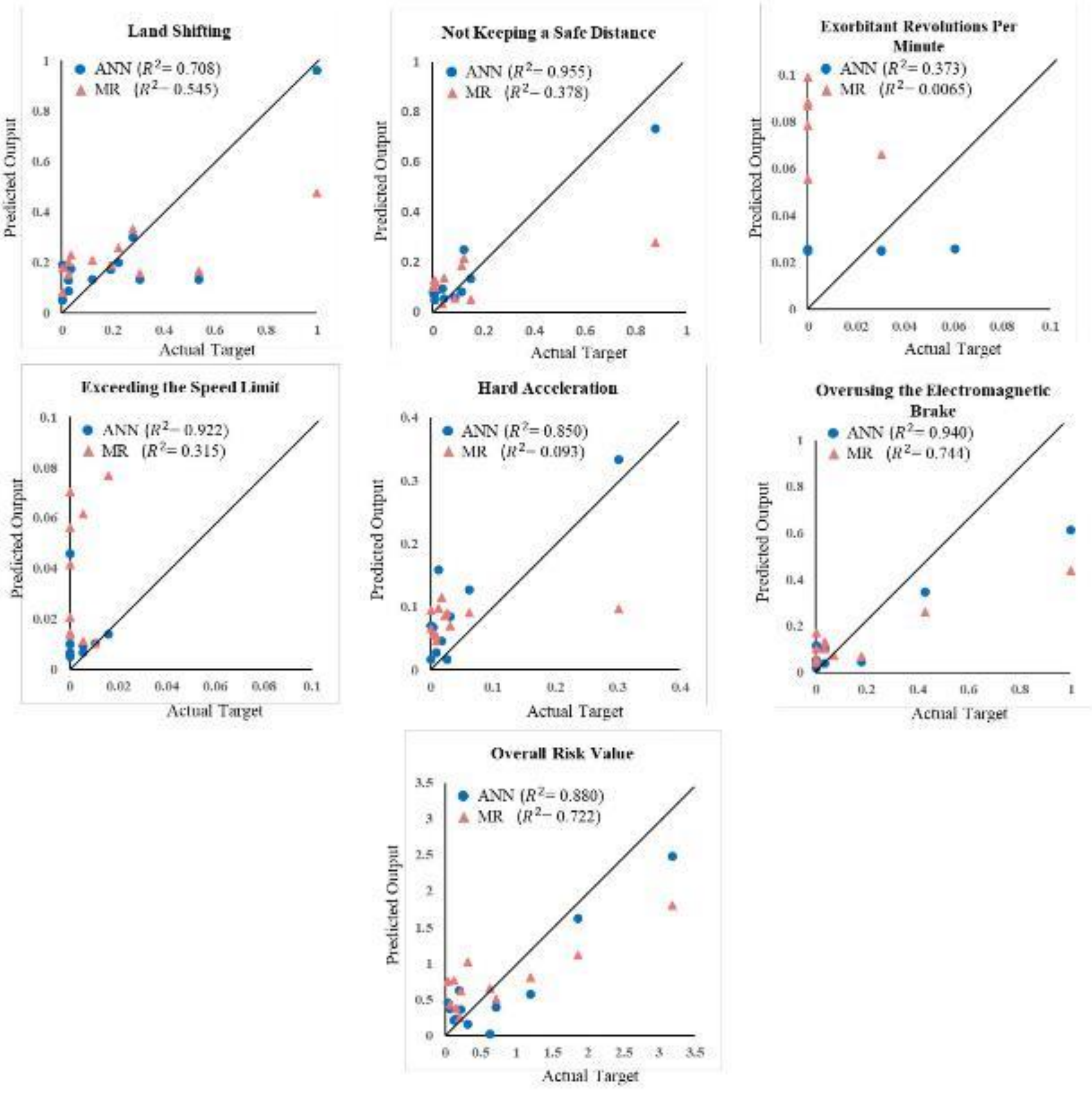


Figure 4. Performance of testing data

From Table 1 and Figure 4, we can identify advantages of the ANN model. Both the ANN model and the multiple regression model perform well in simulating overall driving risk value, and the ANN model is slightly better. However, when it comes to simulating the risk value of individual aberrant driving behavior, the ANN model is far superior to the multiple regression model. The ANN model is only weak in simulating the driving risk value of exorbitant revolutions per minute, with other risk values of aberrant driving behavior being well simulated.

The ANN model is able to predict the relationship between personality and aberrant driving behavior. Table 2 shows the results of a sensitivity analysis. Overall, agreeableness was the most significant variable impacting the risk value, followed by extraversion, neuroticism, conscientiousness, and openness to experience.

Table 2. Sensitivity analysis*

Aberrant Driving Behavior	Agreeableness	Conscientiousness	Extraversion	Neuroticism	Openness to Experience
Land Shifting	2.586	1.493	1.688	1.035	1.441
Not Keeping a Safe Distance	4.617	0.939	1.231	1.608	0.706
Exorbitant Revolutions Per Minute	1.000	1.000	1.000	1.000	1.001
Exceeding the Speed Limit	1.020	0.998	1.063	1.045	1.033
Hard Acceleration	1.496	1.155	1.261	1.242	1.069
Overusing the Electromagnetic Brake	2.612	0.882	1.991	1.665	1.093
Overall Risk Value	3.836	1.111	2.548	1.264	0.885

*The value means the relative importance, and each value is the average value of 10 random networks

Driving Risk Level

The 62 drivers were graded into five levels, following the rules of fixed interval and fixed percentage. Table 3 shows the grading results.

Table 3. Grading Results

Risk Level	Grading Result			
	Fixed Interval		Fixed percentage	
1	44	71.0%	6	9.7%
2	8	12.9%	13	21.0%
3	8	12.9%	25	40.3%
4	1	1.6%	12	19.3%
5	1	1.6%	6	9.7%

Predicting the Result of Driving Risk Level

The result of the driving risk level was set as the target, and the results of the investigation of the five personality traits were set as the input variables. Regarding the classification of driving risk, training was performed randomly on 50 (80%) sets of driver data, and the remaining 12 (20%) were used for testing. During training, both grading rules performed the correct rate up to 75%. The neural network correctly predicted nine grading results out of 12 random tests. Figure 5 illustrates the testing results. When the predicted output level is lower than the target, the risk level is underestimated, and when predicted output level is higher than actual level, the risk level is overestimated.

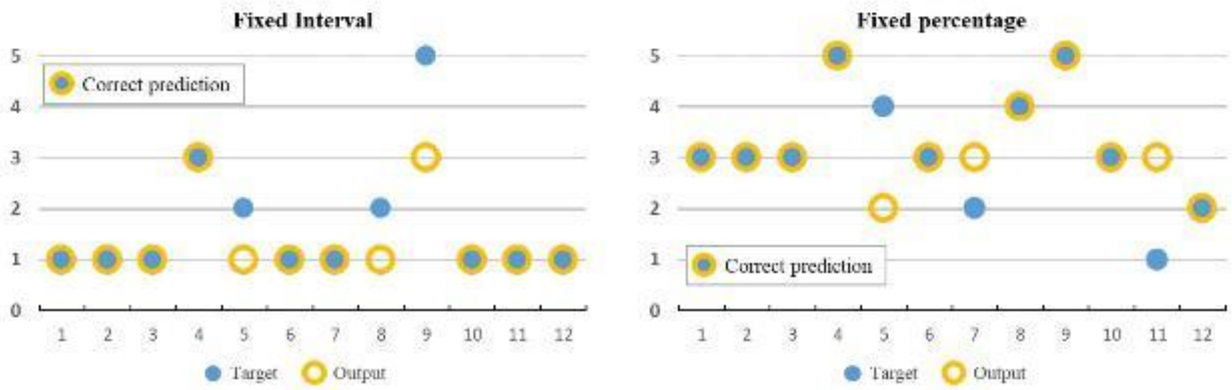


Figure 5. Testing result.

5. Conclusions and Implications

In this study, ANN models were trained to simulate risk values of different aberrant driving behaviors and to predict risk level by investigating personality traits. The ANN models showed better predictive ability than multiple regression models in this case. The risk values of driving behaviors were normalized from the number of aberrant driving behaviors. If the risk value is predicted by the ANN model, denormalizing the risk value into the number of aberrant driving behaviors estimates the number of aberrant driving behaviors (frequency of aberration). For inter-city bus carriers, using this ANN model to simulate frequency of aberration and individual risk value is beneficial. Incentive mechanisms should cooperate with the ANN model, and the predicted risk value could be taken as personal benchmark. That is, drivers who have improved should be rewarded, and drivers who have deteriorated should be punished.

ANN models usually perform well for classification. Previous research has less considered how to model driver personality and driving risk level, nor construct a grading rule to classify drivers. This study applied the ANN model to pre-classify driving risk into five levels. The network correctly predicted 75% of the cases during the test. For the two grading rules, different aspects could be applied. In the rule of fixed interval, most drivers were classified into the first level. Thus, the first level could be considered a standard risk level. Levels 2 to 5 could be defined as growing dangerous. In the rule of fixed percentage, 40% of drivers were classified into the third level. Thus, the third level could be viewed as a standard risk level. Levels 4 and 5 would be high risk, and levels 1 and 2 would be low risk. Both grading rules could be utilized as new recruitment criteria to identify drivers classified as high risk. This would improve road safety and enhance reputation for bus carriers.

In Figure 5, several risk levels were overestimated or underestimated. The ANN model tended to underestimate risk levels with the rule of fixed interval and overestimate risk level with the rule of fixed percentage. The underestimated outputs would result in not identifying drivers with higher risk levels, so it seems reasonable to choose the fixed interval grading rule for risk control and personnel management. However, it is still important to avoid underestimating risk level. To enhance the accuracy of classification, the ANN model could be better trained by investigating more samples. Further, transforming driving behaviors into driving risk values by applying different formulas about normalization would change the relative danger for each driver.

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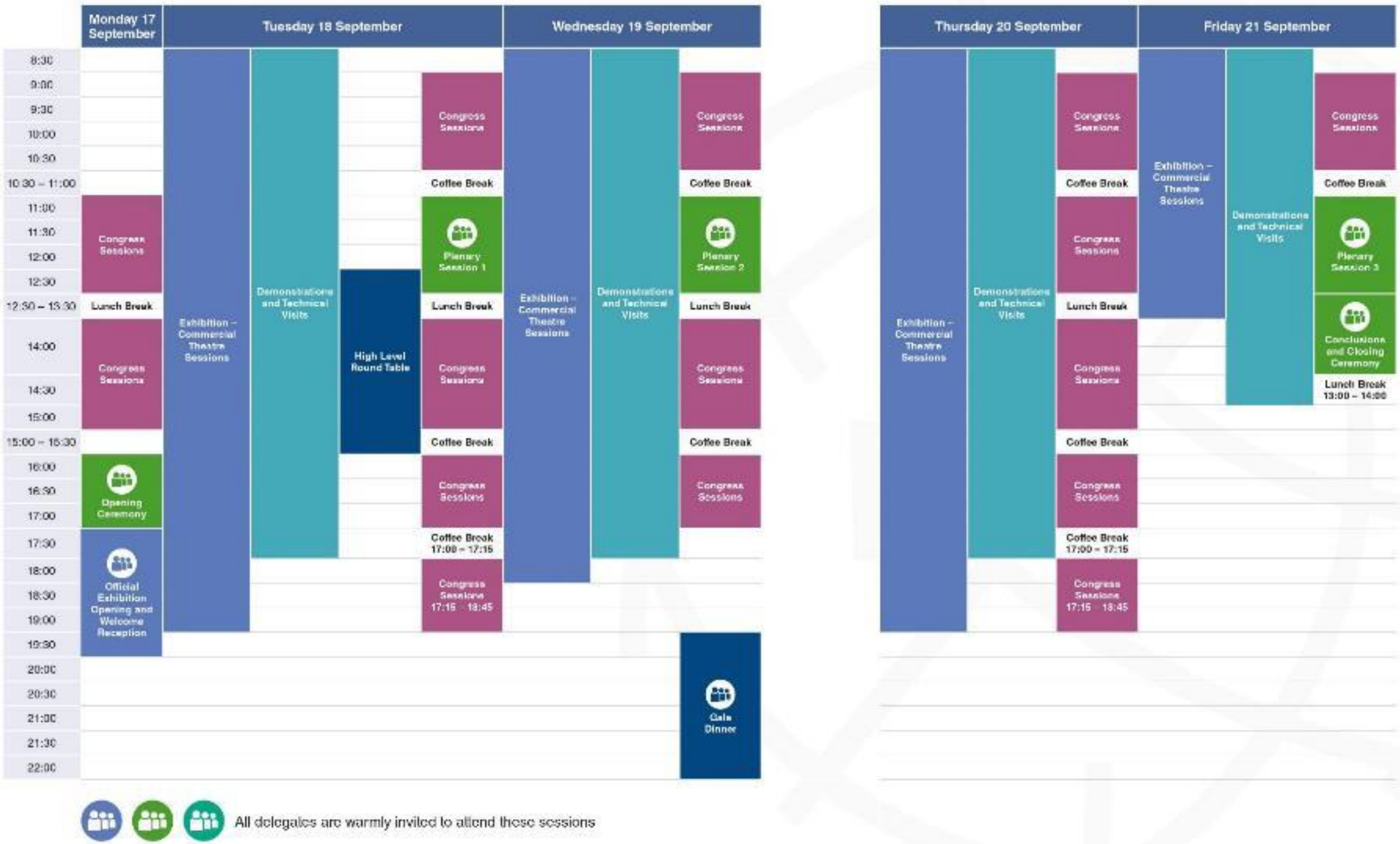
附錄 2 議程表與展覽場平面圖

Week at a glance



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Quality of life

Programme at a glance

25th ITS World Congress

Copenhagen, Denmark, 17 – 21 September 2018

	Bella Center: Auditorium Bordeaux	Bella Center: Auditorium Vienna	Hall B: Tokyo	Hall B: Montreal	Hall B: London	Hall B: Madrid	Hall B: Turin
Monday 17 September							
11:00 – 12:30			SIS01 Comparing permits authorising trials of automated vehicles: Which works best?	TS01 Legal and governance issues	SIS02 Communication technologies for connected vehicles and automated driving		TS02 City air quality
Lunch (12.30 – 13.30)							
13:30 – 15:00			SIS09 Legal framework for AV accident	TS05 The future evolution of ITS	SIS10 Assessing next generation technologies for emerging future transportation ...	SIS03 Bringing new products and services to market	TS06 Electromobility
16:00 – 17:30	Copenhagen Hall: Opening Ceremony						
Tuesday 18 September							
09:00 – 10:30			SIS16 Automated buses: the future of (last-mile) public transport?	TS10 Better parking terminal operations	SIS17 Evolution from current automotive connectivity and ITS deployments to 5G and 5G-V2X	TS11 Communication Technologies 1	SIS18 ITS for Life
Coffee Break							
11:00 – 12:30	PL1 Achieving higher quality of life in our cities						
Lunch (12.30 – 13.30)							
13:30 – 15:00	ES01 Healthy and liveable cities	ES02 Putting citizens first in mobility design	SIS23 Deployment of Autonomous Shuttles on Public Roads – experiences from Different Countries	TS15 Safety	SIS24 Smart Villages: ITS in Rural Areas	TS16 Standards and architecture	SIS25 Promoting Electromobility integration in urban environment
Coffee Break							
15:30 – 17:00	ES03 Lead tools to developing a smart city	ES04 Managing the access and flows of travel	TS20 Public transit systems	TS21 User acceptance	SIS28 Cooperative ITS Standards Gaps	TS22 Communication technologies 2	SIS29 Copenhagen CO2-Neutral by 2025
Coffee Break							
17:15 – 18:45			SIS34 Autonomous Vehicles in Public Transport	SIS35 Strategic and Practical Implementation of V-Cooperative Systems for Traffic Accident Avoidance	SIS36 IoT sensing automated vehicles ...	SIS37 From Problem to Prototype: A Coordinated Use-Case Based Approach	SIS38 Challenges of a common methodology to assess ITS impact on reducing emissions
Wednesday 19 September							
09:00 – 10:30			SIS42 Automated shuttles – lessons from trials and the path to deployment	TS27 Vulnerable Road Users	SIS43 Technical Challenges to Integrating Low Speed Automated Vehicles into the Transportation Network	TS28 Roadmaps to deployment	SIS44 Smart metrics for smart cities – traffic signals' contribution to liveability
10:45 – 11:30							
Coffee Break							
11:00 – 12:30	PL2 Ensuring integrated mobility services						
Lunch (12.30 – 13.30)							
13:30 – 15:00	ES05 MaaS: Seamless and effortless mobility	ES06 Institutional and legal challenges of CCAM	SIS48 Effective Measures of Success: The United States Connected Vehicle Pilots	TS32 V2X Solutions & Concepts	SIS49 Fast deployment of V2X using cellular networks and mobile services	TS33 Sensing, detection classification	TS34 Testing new approaches 1
Coffee Break							
15:30 – 17:00	ES07 The role of Open Data in the digital infrastructure – AM	ES08 Efficiency in freight transport – EU	SIS53 Impact Assessment of Automated Vehicles on Traffic flow and Environment	TS38 Traffic management and connected infrastructure	SIS54 Establishing a Large-Scale Security Credential Management System for V2X Communication	SIS55 Fusion of road infrastructure and vehicle sensor data for automated driving	TS39 Signal optimising and traffic management

Topics: Mobility services, Environment, Automation, Freight, Satellite, Transport networks, Cross-border

	Hall B: Berlin	Hall B: Paris	Hall B: Orlando	Hall B: Sydney	Hall B: Melbourne	Hall B: Nagoya	Hall B: Europe	Hall B: Stockholm Nordic stream	Exhibition – Hall C: ITS Forum	Exhibition – Hall C: Theatre
Monday 17 September										
11:00 – 12:30		TS03 Traffic data 1	SIS05 Maximise the potential and the market uptake of the GNSS in mobility	SIS06 IEEE ITS resources to aid practitioners and decision-makers	TS04 Open data and information	SIS07 Rural MaaS – from definition to action	SIS08 ITS for Persons with Reduced Mobility (PRM)			
Lunch (12.30 – 13.30)										
13:30 – 15:00	SIS12 Defining Smart Cities: What is Best for its Citizens?	TS07 Traffic data 2	TS08 Satellite services and mapping	SIS13 Public and private partnership towards Quality of Mobility and Quality of Life	TS09 Network management tools	SIS14 User-centric approaches enabling automated vehicles in mixed traffic	SIS15 IoT advancing Automated Mobility and Smart Cities for improved Quality of Life	NS0 Cross border mobility solutions towards a seamless Mobility: the ITS Nordic way		
16:00 – 17:30										
Tuesday 18 September										
09:00 – 10:30	SIS19 The Best Traffic Management with Open Big Data to Automated Driving ...	TS12 Realising MaaS	TS13 Traffic flow and data	SIS20 Improved Situational Awareness to Drive Improved Operations	TS14 Public Private Cooperation	SIS21 How to build a roaming ecosystem for MaaS?	SIS22 Cashless paying for mobility in 2015	NS1 The technical platform for seamless travelling	C40 Opening Masterclass: Healthy & Liveable Cities – experience from leading cities	
Coffee Break										
11:00 – 12:30										
Lunch (12.30 – 13.30)										
13:30 – 15:00	SIS26 Intelligent Operations Models for Mobility-as-a-Service	TS17 Data and public transport	TS18 Road safety measures and applications	SIS27 The value chains of (interactive) traffic management	TS19 Use of tolling in network operations	SP01 Environmental studies	SIS63 Accessing Travel and Traffic Data in the EU	NS2 Cross stakeholder real-time maritime information sharing – why now?	Workshop: Connected, convenient and sustainable – how cities can accelerate cycling through intelligent mobility solutions	CP1 Urban living services 1
Coffee Break										
15:30 – 17:00	SIS30 Predictive Analytics for Intelligent Mobility	TS23 Seamless travel	SIS31 ... with Satellite – Delivering Resilience and Reach	SIS32 Advanced technologies for operation and maintenance of ITS Roadways	SIS33 Using Big Data to Reduce Congestion & Promote Government Spending	SP02 Users' needs and social factors 1	Workshop: Transforming Freight Movement through ITS	NS3 How can Self-Driving Feeder Services Improve Public Transport?	Start up prize	[illegible] commercial presentation
Coffee Break										
17:15 – 18:45	SIS39 Mobility as a Service – new business and service approaches	TS24 Living Labs and Human factors	TS25 Positioning and fleet management	SIS40 Cooperative ITS services moving from cross-border interoperability to harmonisation	TS26 Traffic demand strategies	SP03 Users' needs and social factors 2		NS4 Automation and safety – sea, road and railway	SIS41 Smart city European initiatives you want to meet: opportunities for a data industry	Science driven innovation for smarter, greener and safer roads
Wednesday 19 September										
09:00 – 10:30	SIS45 Challenges on testing and validation of automated driving	TS29 ITS for ageing population	TS30 Charging and fleet management	SIS46 Using analytics to drive better decisions and improve transportation service delivery	TS31 Improving intersection management	SP04 Safety 1	AB EU and Global opportunities for financing ITS	NS5 CaaS Corridor as a Service	SIS47 Future of Mobility: The questions we are afraid to ask	TELEGRA commercial presentation
10:45 – 11:30										SALNA commercial presentation
Coffee Break										
11:00 – 12:30										
Lunch (12.30 – 13.30)										
13:30 – 15:00	SIS50 Sharing data for traffic information between road authorities and service providers	TS35 MaaS planning & policy	SIS51 Autonomous Freight Vehicles: Benefits, Risks and Governance	TS36 Network security	TS37 Cross-border solutions	SP05 Safety 2	SIS52 Implementing MaaS in Europe: state of the art and expected impacts	NS6 Travellers Needs in Transport traffic information in a Unified Nordics	Workshop: how cities use cycling and ITS to develop a sustainable and smart transport system	CP2 Data services
Coffee Break										
15:30 – 17:00	SIS56 Preparing next generation mobility	TS40 Behavioural factors 1	SIS57 Modelling the impact of Smart Mobility with traffic and transport simulation models	TS41 Motorway operations	TS42 Network management policies	SP06 Security, testing and validation	SIS58 Secure and precise positioning: a key to success for autonomous driving	NS7 ITS deployment corridors		

Session types: PL: Plenary Session ES: Executive Session SIS: Special Interest Session TS: Technical Session SP: Scientific Session CP: Commercial Paper Session NS: Nordic Stream

Programme at a glance

	Bella Center		Hall B				
	Auditorium Bordeaux	Auditorium Vienna	Tokyo	Montreal	London	Madrid	Turin
Thursday 20 September							
09.00 – 10.30	**ES09** Delivering effective CCAM	Workshop: ITS Security and Safety Issues for Automated Vehicles & MaaS 9.00 – 11.00	**SIS59** Road authorities and operators and connected, cooperative transport	**TS43** Traffic management and connected infrastructure 1	**SIS60** Cybersecurity for Public-Facing ITS Systems	**TS44** Testing and simulations	**SIS67** Enabling electromobility services interoperability and enhanced performance of electric vehicles
Coffee Break							
11.00 – 12.30	**ES10** The real impacts of CCAM	Part 1: TM 2.0 and Public Authorities as Service Providers in Traffic Management	**SIS65** Data in autonomous driving: different strategies to data accessibility	**TS49** Mixed traffic and transitions	**SIS66** Open Auto Drive Forum: A New Cooperation Approach for Automated Driving Ecosystem	**TS50** Security	**TS45** Vehicle detection and network efficiency
Lunch (12.30 – 13.30)							
13.30 – 15.00	**ES11** Enhancing the cybersecurity & resilience of transport infrastructure	Part 2: TM 2.0 and hybrid infrastructure as enablers for MaaS in the context of automated transport		**TS55** Impact evaluation	**SIS72** Taking automated driving to the next level: solving challenging environmental conditions	**TS56** Traffic Control and Data	**SIS73** Connected Vehicle Certification Today, Tomorrow and Beyond
Coffee Break							
15.30 – 17.00	**ES12** Upping the game in safety		**SIS76** Investigating the emerging employment opportunities created by future transport technology	**TS62** Modelling and simulation	**SIS77** Automated vehicle data sharing enabled by Feature Extraction and Anonymisation	**TS63** Alertness in automated vehicles	**SIS78** Deploying Connected ITS in small cities
Coffee Break							
17.15 – 18.45			**SIS84** Highway chauffeur and high density truck platooning in real-time [illegible]	**TS86** Traffic management and connected infrastructure 3	**SIS85** Integrating Technology, Data, People and training for Successful Traffic Incident Management	**TS87** Data and ITS	**TS88** CAV Testbeds 1
Friday 21 September							
09.00 – 10.30			**SIS90** Deploying C-ITS services and Learning from evaluations	**TS72** Traffic management and connected infrastructure 4	**TS73** Testing new approaches 2	**TS74** Automated decision making	**TS75** CAV Testbeds 2
Coffee Break							
11.00 – 13.00	**Auditorium Hamburg** PL3 What's next for automated mobility? + Conclusions + Closing Ceremony						
Lunch (13.00 – 14.00)							

Hall B								Exhibition – Hall C	
Berlin	Paris	Orlando	Sydney	Melbourne	Nagoya	Europe	Stockholm Nordic stream	ITS Forum	Theatre
SIS51 Missing Work Zones Scenarios	**TS46** Behavioural factors 2	**TS47** Using technology to deliver goods	**SIS62** Traffic IOT sensing by various manners	**TS48** Travel time estimation	**SP07** Data and information	**SIS52** The Digital Transport and Logistics Forum (DTLF) headway towards digitised and connected supply chains	**NS8** Arctic Showcase and the Automatisation of Transport System		
TS51 Mobility on demand	**TS52** Enhancing safety 1	**TS53** Improving freight flows – logistics and innovation	**SIS68** ITS and Cognitive technologies: Exploiting Artificial Intelligence and Machine Learning	**TS54** Traffic flow control	**SP08** Network management	**SIS69** Systemic impacts from infrastructure, traffic management of connected and automated driving	**NS9** 5G/5G spectrum use and telecom connections with C-ITS	**SIS70** State of the future towards automation	ITS WC Singapore 2019 promotion
TS57 ITS and mobility	**TS58** Enhancing safety 2	**TS59** Improving freight flows – logistics and smart data	**TS60** Road management operations 1	**TS61** Traffic Safety	**SP09** Simulation and modelling	**SIS74** European Cooperative Connected and Automated Mobility (CCAM)	**NS10** Open Ecosystem for Mobility as a Service	**SIS75** Orchestration for MaaS – The future of public transport	**CP3** Network management services
SIS79 ITS for Shipping Ports and logistics and ensuring a network data exchange: Part I	**TS64** Enhancing safety 3	**SIS80** Across the Pavement – smart freight delivery for the last metres	**SIS81** Impacts of AVs on Pavement	**TS66** Road management operations 2	**SP10** Commercial vehicles and freight solutions	**SIS82** Large scale deployment of C-ITS: Challenges and ways forward	**NS11** Better mobility with Public Transport	**SIS83** ITS decision-making in the round	
SIS85 ITS for Shipping Ports and logistics and ensuring a network data exchange: Part II	**TS69** Life scale & ITS planning	**SIS87** User friendly road infrastructure matched to multiple road users [illegible]	**TS70** Data driven traffic management 1	**TS71** Modelling and effective traffic management 1	**SP11** Deep learning	**SIS88** C-ITS Deployment becoming reality in Europe by 2019	**NS12** Nordic test areas and demonstration sites	**SIS89** Discussing the impact of automated driving a serious game	
TS76 Smart Parking	Smarter Mobility for Connected Two-Wheeler Safety		**TS77** Data driven traffic management 2	**TS78** Modelling and effective traffic management 2	**TS79** ITS for cycling		**NS13** MaaS in your life – The delegate tool?	Research that Defines the Future of Mobility	**CP4** Urban [illegible] services 2

Topics: Mobility services | Environment | Automation | Freight | Satellite | Transport networks | Cross-border

Session types: PL: Plenary Session | ES: Executive Session | SIS: Special Interest Session | TS: Technical Session | SP: Scientific Session | CP: Commercial Paper Session | NS: Nordic Stream

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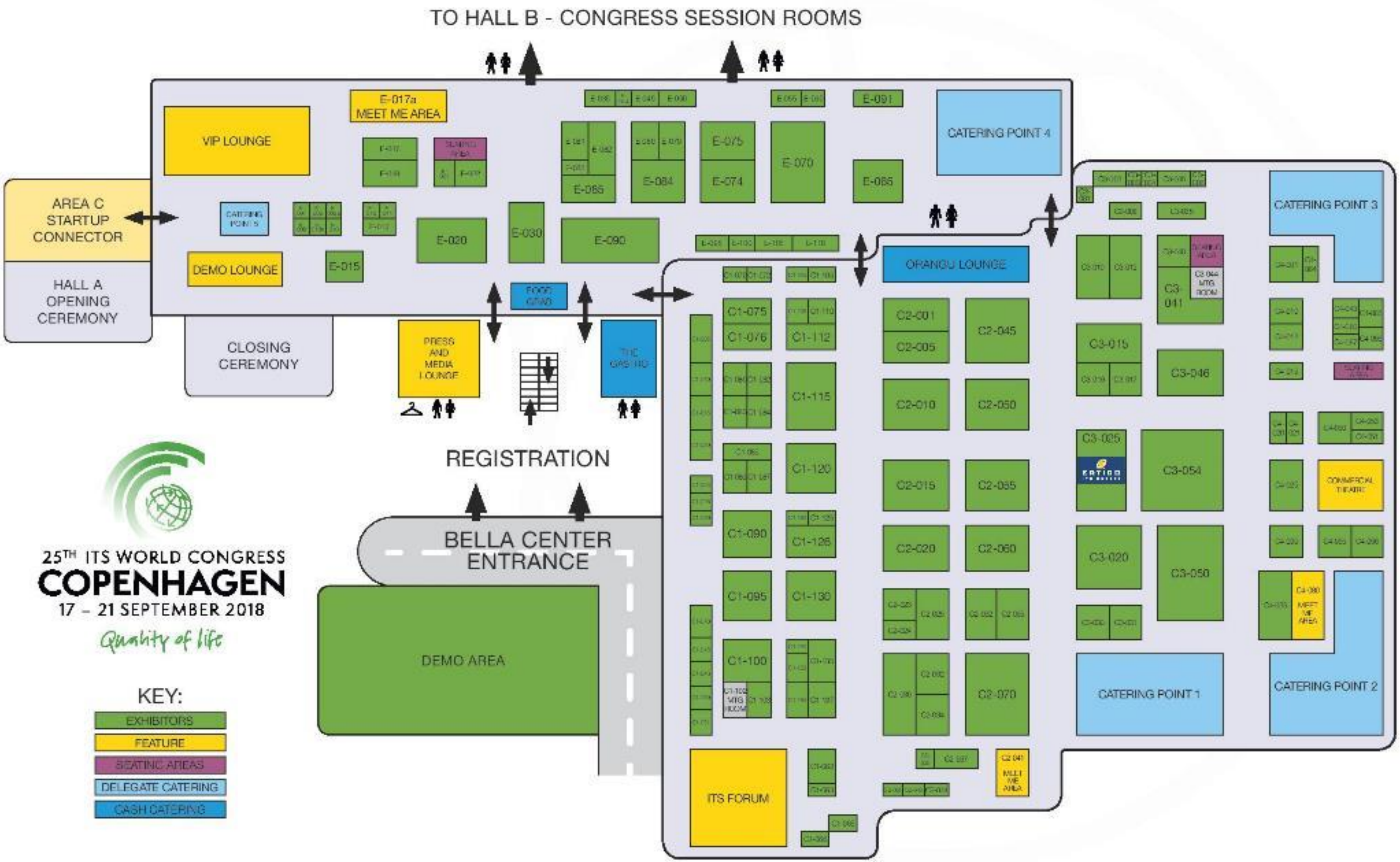

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