Tourism Mobile Recommender Systems: A Survey

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***Abstract*— The growth in tourism industry shows a positive trend in Indonesia because of human needs, infrastructure, and the Internet to support it. To link these aspects, tourists need mobile recommender systems to make everything handle and control easily. From one system tourists can get access to the information, plan their itinerary, get the suggestion, and share the experience. The collaborative, content and hybrid method become the source to enjoy the journey. This paper will show the progress in a last ten years, and what future research that still open to explore.**

Keywords — tourism; recommender system; mobile device; m-government; Orienteering Problem

I. Introduction

Traveling become one of the popular hobbies that growth very fast in this decade. Human needs traveling as the way to entertain, to skip for a while from the routine activities, and to get inspirations. The entire things that they want to enjoy push them to plan it well and make it controllable. That is why they need good information, because usually it takes their time but they have never come to the destinations. It becomes a gambling and they try to reduce the risk.

Government and private company as the administrator of the destination has a big job to coordinate, facilitate and run this business seriously. Tourism becomes one of the prospecting fields besides mining and export commodity that give most of the foreign exchange in a country. The World Tourism Organization's [1] predicts on 2020 international arrivals will almost 1.6 billion, which 1.2 billion of it is from the neighbour countries and 378 million will be long-haul travellers. The top three regions are Europe (717 million tourists), East Asia and the Pacific (397 million) and the Americas (282 million), followed by Africa, the Middle East and South Asia. This good thing is also happened in Indonesia, especially East Java while this province got the highest percentage on total traveling amount from all the provinces in Indonesia in 2014.

Increasing of the wealth of local people, awareness to appreciate the beauty of Indonesia, and improvement in infrastructure make citizen change the tourist's role. The government reduce the irregularity that makes tourists uncomfortable and unsafe in their own country. Government also promotes frequently on media about destinations in Indonesia. The government repairs the access to get there, improve the transportation mode and network, develop a better regulation, and evaluate the private company who can run the tourism business in specific standard.

Information is the important key to fulfill the tourists' expectation. The more positive information that tourists get, the more interesting to visit that destination. It will be better if the responsible organization like the government by using m-government can handle the information. Even though sharing is good because the data will be very dynamic and update, in other hand it can spread the negative experience that maybe not every people feel it. With a growing fast of the Internet penetration and the life style using a gadget, it will encourage tourists to get access to the information frequently. This is become a challenge because if too many websites shows the information, it will be more difficult for the tourists to filter it. Another challenge is how to make the websites more valuable, not only shows the data.

This is the time for tourism mobile recommender systems to come. The growth of the internet era and mobile device make the user easier to access the information and operate some traveling applications. Brown and Chalmers [2] did the ethnographic study of the city. They tried to classify the technology needs, from how the tourists work in group, share their knowledge about surrounding on maps and guidebooks, and places that they visit in pre and post destination. The interest thing that concludes from this research is good tourists' technologies are not only those that make tourists more efficient, but also make them enjoy to use it. Sharing is important too because tourist as a human need social interaction. This research continues with Liu et al. [3] who used travel information from the internet for personalized travel recommendation. They built Tourist-Area-Season Topic (TAST) model, using a Bayesian network and follows a hybrid recommendation, combination of collaboration and content resource. It is the same with Sharma and Gera's research [4] that classified recommendation techniques into three major categories: Collaborative Filtering, Content Based and Hybrid Recommendations. The collaborative will filter the process work by collecting user feedback. The content-based recommendation system will consider user's interest and profile, while hybrid recommenders combine multiple recommendations techniques. Vansteenwegen and Oudheusden [5] started their research by building model that consider changes in weather condition suddenly or modification in opening hours. So they created Next Generation Electronic Tourist Guide or ETG. The ETG will

aware to the tourists' preferences and it is connected to the Internet.

Orienteering problem is one of the algorithm that is used in many recommender systems. Even though this algorithm was not for traveling problem in the beginning, most of the research adopt this algorithm into a specific application. Orienteering problem can be very suitable for specific condition like using public transport or bicycle, with or without time window, multi objective or single objective, and many more.

In many papers there are some variations of classification, progress in research to continue the previous research, and many ideas to implement. From the last ten years, this paper will show the mobile recommender systems that has already developed, and then we can learn something from them and try to make it better.

II. Literature Review

A tourism mobile recommender system is developed to answer the need of the tourist: suggestion. In the middle of confusion and curiosity to visit a new destination, they need the suggestion for what to do, how to get there, and how long it takes. These are the common questions that happen in many tourists. Mobile recommender systems try to solve this by considering all the aspects: tourist as the user, destination and environment; all of these aspects become integration that we cannot plan it separately.

The applications are classified into three groups. The first group is the recommender system that applies as a website or mobile application. For the entire prototype usually they choose website for the first because it is easier to make it happen than build the application, so they can do the validity and verification test immediately. Then they will continue with the mobile application because it is more practical and easier to use for the user. There are two views in here, first is the developer and second is the user. Website make easier for the developer but a bit difficult for the user, otherwise mobile application is difficult to build but it needs less effort for the user. Each of option has the strengths and weakness, and sometimes it is not only the good and bad, but related to the image, a practical consideration, and the policy.

Another classification is the recommender system only shows the information or it can give the suggestion. Some applications show the information of the destination, service near the destinations (e.g. restaurant, souvenir shop) and location by map, other can suggest the itinerary. System will arrange the journey, which destination must be visited on sequence and on what time, continue with other destination. With the specific algorithm they will optimize the result, based on tourists' preference and the information that they save.

GUIDE is a system for giving information, which developed by Cheverst et al. [6]. GUIDE is a prototype system with context-aware information city visitors that combine personality of tourist and environmental information. Schmid-Belzt et al. [7] developed CRUMPET as more personalized, location-detection for tourism service, and using multi-agent system to mediate and interact the facilitations. Turist@ that was built by Batet et al. [8], was different because it gives information while the tourist already on the spot. Ponnada and Sharda [9] made Intelligent Visual Travel Recommender system (IV-TRS). It uses visual information such as video, images and audio, to give a presentation of a virtual tour to the destination.

Dietorecs [10] uses a human decision model that focus on differences in decision styles and using statistics. It incorporates tourist preferences and tourist behavior [11]. Gavalas and Kenteris [12] although extend the research in routing, they also built MTSR, to give information based on behaviors, evaluations or ratings from other tourists who have similar interests, This system is utilizing collaborative filtering techniques and contextual information like place, time, weather and places already visited by other user. Kawai et al. [13] created a system that will give the tourists a system to search efficient route that recommends the journey among several destinations and suggests the path with beautiful scenic site using the information from the Web. After generating route candidates using GIS, the system uses 3D virtual space and Z-Buffer method to decide which route is visible to be followed.

Most of the routing algorithm using Orienteering Problem as a base, then it was modified to fit with the real condition. Lim et al. [14] developed PERSTOUR algorithm for giving suggestion a customizable journey based on the user needs using destination popularity and user interest preferences. They used Orienteering problem, and considers the constraints like time budget, and different start and end node. Vansteenwegen et al. [15] built a web application, City Trip Planner, that combines the interests and limitation given by the user and matches the information with database of destinations to predict the personal interests. An efficient and effective planning algorithm will provide recommendation in a minimum time as a personal trip for several days, consider time window and time for a lunch or break. Soffriau et al. [16] used artificial intelligence and metaheuristic approach to solve tourist trip design problems (TTDP). The orienteering problem become the starting point for modeling the TTDP, then it continued with guided local search metaheuristic. A set of possible destinations have a score for each of them and the goal is to maximize the total score of the visited destinations, but still fulfill the limited time budget. Chen et al. [17] used Team Orienteering Problem to create an itinerary for the backpack tourist. First they did the pre-processing stage and continued with weighted set-packing problem, which is an efficient approximate algorithms. Gavalas et al. [18] created DailyTRIP, a heuristic approach for personalized recommendations from daily tourist itineraries. This approach considers user preferences, time budget, time window for each destination, and average visiting times. The objective is

to maximize the score that related with visited destinations while still consider the time budget in a day, or using TOPTW (Team Orienteering Problem with Time Window).

Another adjustment of Orienteering problem is called Time Dependent Orienteering Problem (TDOP). Garcia et al [19] used Time Dependent Team Orienteering Problem with Time Windows (TDTOPTW) because they consider about public transportation and the suggestion routes are more than one. They continued it in 2013 by creating Personalized Electronic Tourist Guides (PETs) to arrange tourist itinerary by considering tourist's preferences and integrating public transportation. Even though Orienteering Problem becomes the most algorithms that were usually used, Herzog and Worndl [20] developed an algorithm based on an approximation for the Knapsack problem. This algorithm can predict the optimal visiting time per region and measure the performance from the newest database. Table 1 is a list of information and routing applications.

TABLE 1. INFORMATION AND ROUTING APPLICATIONS

Information	Routing
Brown and Chalmers, 2003	Chen et al., 2011
Liu et al., 2011	Garcia et al., 2010
Vansteenwegen and Van Oudheusden, 2006	Garcia et al., 2013
Cheverst et al., 2000	Brilhante et al., 2013
Schmid-Belzt et al., 2003	Lim et al., 2015
Batet et al., 2012	Vansteenwegen et al., 2011
Fesenmaier et al., 2003	Gavalas and Kenteris, 2011
Ponnada and Sharda, 2007	Souffriau et al., 2009
Ricci et al., 2006	Herzog and Wörndl, 2014
Averjanova et al., 2008	Bitonto et al., 2010
Bellotti et al., 2008	Gavalas and Kenteris, 2011
Kenteris et al., 2009	Kawai et al., 2009
Poslad et al., 2013	Lu et al., 2011
Rey-lópez et al., 2011	Gavalas et al., 2015
Savage et al., 2012	Kenteris et al., 2010
	Maervoet et al., 2009
	Maruyama et al., 2004
	Tumas and Ricci, 2009

Using a public transportation develops another group of recommender systems. If they consider about it, so they will deal with the time dependency. Time dependency is time that connected each other, and the earlier time in previous destination will influence the next destination. Tourist will consider about transit time, to connect all of transportation mode and concern in cost that they must spend. This problem is less in single mode transportation, unless if the tourist uses cycle, it becomes an interesting topic to explore.

For multimodal transportation, Gavalas et al. [33] created eCOMPASS, a context aware web and mobile application which derive personalized multi-mode transportation to selected destinations. eCOMPASS can accommodate different start or end locations and make scheduling lunch breaks at nearest restaurants located along the recommended destinations. There are three variants of public transportation approach. The first only considers direct public transportation connections, without any transfer. The second variant is the same like the first variant, but now using transfer. The third variant makes transfer as direct connection. Table 2 will show multi-mode and single mode group of papers.

TABLE 2. MULTI-MODE AND SINGLE MODE TRANSPORTATION IN APPLICATIONS

Multi mode	Single mode
PECITAS - Tumas and Ricci, 2009	City Trip Planner – Vansteenwegen et al., 2011
PET – Garcia et al., 2010	DailyTRIP – Gavalas et al., 2011
eCOMPASS – Gavalas et al., 2015	P-TOUR – Maruyama et al., 2004
N/A- Garcia et al., 2013	TripBuilder – Brilhante et al., 2013
Herzog and Wörndl**,** 2014	MACTPP – Černá et al., 2014
	PERSTOUR – Lim et al., 2015
	SCENIC ATHENS – Gavalas et al., 2016
	N/A – Kawai et al., 2009

Maruyama et al. [36] developed P-Tour to compute a semi-optimal schedule in reasonable time using techniques of genetic algorithms and the assumptions is the tourist use single mode of transportation. Cycle become favorite single mode transportation that was built by Cerna et al. [38] in Most Attractive Cycle Tourist Path Problem (MACTPP) and Gavalas [39] in Scenic Athens, a context-aware mobile city incorporating scenic by walking.

The last classification is from what source recommender system gets the data. There are collaboration which users can share their experience and become information for the other users. This source will mine from the social media, geo-tagging or travel website. Other source is content, it means the developer will create the information and update it. The last is hybrid that combines collaborative and content to work together. This source will complete each other to get better information. Table 3 will show the group of the applications about the source of information.

The application could be the website or mobile application. For the website even though it was created for the desktop or personal computer, it was more flexible because it could change the format and size that fit with gadget monitor. The strength of the website was it can open in every browser. But the website also had the weakness, this system was less stable, the feature was less than mobile application, not user-friendly and slower. Comparing with the mobile application, the application is specially design for a function, so it will be more effective. It can adjust the limitation, accommodate more complex analysis and do the continuous improvement. On the contrary, it needs specific requirement for the operating system, like Symbian and Java.

TABLE 3. SOURCE OF INFORMATION IN APPLICATIONS

Collaborative	Hybrid	Content
Brown and Chalmers, 2003	Liu et al., 2011	Vansteenwegen and Van Oudheusden, 2006
Bellotti et al., 2008	Chen et al., 2014	Gavalas et al., 2012
Rey-lópez et al., 2011	Garcia et al., 2010	Herzog and Wörndl , 2014
Noguera et al.,	Brilhante et al., 2013	Bitonto et al., 2010
	Lim et al., 2015	
	Cheverst et al., 2000	
	Gavalas and Kenteris, 2011	

2013	Ricci et al., 2006 Gavalas et al., 2015 Kenteris et al., 2010 Maervoet et al., 2009 Noguera et al., 2015 Poslad et al., 2013 Rey-lópez et al., 2011 Tumas and F. Ricci, 2009 Savage et al., 2012	Schmid-Belzt et al., 2003 Batet et al., 2012 [10], Fesenmaier et al., 2003 Lu et al., 2011 Ponnada and Sharda, 2007 Averjanova et al., 2008 Kenteris et al., 2009 Cenamor et al., 2013

MapMobyRek by Averjanova et al. [23] is an approach for integrating recommendation using electronic map technologies. Bellotti et al. [24] created context-aware mobile recommender system, Magitti. Magitti uses user activities from context and patterns of user behavior to automatically generate recommendations for content matching. Kenteris et al. [34] selected destinations that tourist would potentially choose it and derive a near-optimal itinerary for everyday. They created DailyTRlP, a heuristic approach to give personalized recommendations of daily itinerary for visiting any tourist's favorite destinations. On Nokia N85 smart phone, Maervoet et al. [35] created application to maximize the interest of the tourist, while considered time window and the available time. Rey-lopez et al. [27] proposed moreTourism, a hybrid recommendation system for smartphones, and provided tourist information profile from other users sharing experience. Tumas and Ricci [37] built PECITAS where the user can get recommendations for personalized paths between two destinations in the city directly on his or her device. For all the mobile recommender systems that was built in Europe, Huijnen [41] summarize and explain each application to see the difference. Gavalas et al. [42] also did it based on the papers they have read.

III. Further Research

From all the previous review paper, most of them stated the future works that can continue by other researcher. Some of it has already done, such as the need to add weather as one of the services [15] [18] [25] [34]. But there is still some chances to find out the state-of-the-art about their suggestions. Cheverst et al. [6] gave suggestion based on their prototype, GUIDE. It should need low-power, micro-cellular, and using wireless communications technologies like Bluetooth. They hope GUIDE can work well inside the building and can find the other potential context-aware interactive services. It can work in remote area too, and can keep the history to make mobile interactive system more personalize. Stabb et al. [46] need a future system that is flexible to install and use. Another device problem that could be the future work is stated by Saiph et al. [28] about the cycle on the mobile device to get the longer battery life. There is also a need to make the device is eyes-free interface while the user still on going.

For the application itself, it can classify into two groups, modifying the process which is the algorithm or the database. Finding a new algorithm or extend it will discuss in another paper; the important thing is the process must be fast and more personalize [46]. The database itself needs more accurate, more complete, up to date covering the dynamic data, and even though it comes from a huge data, filter is a must to make is a useful information. Garcia et al (2010) plan to add more cities, consider different public transportation network, and share the information. Gavalas et al. [47] will get more accurate data, using metrics and formal evaluation that is more effective and integrated attractions/tourist services recommendations. Another prospect is considering the tourist's limitation budget, the need to get meal or break, walk along the scenic beauty, and integrated multi-mode transportation. More recommendations like travel agencies, souvenir shops, lodging, restaurants, entertainment, and local authorities are suggested by Gavalas and Kenteris [12]. Kenteris et al. [25] will extend the application by concern about ''Location API'', so it can provide orientation, navigation and other location-based services. Gavalas et al. [33] want to improve eCOMPASs to consider spent while on travel, profit (score for the favorite destination) is assigned to arcs in scenic tours, and machine learning for uncertainty on transit services schedules. Tumas and Ricci [37] also consider about multi-mode transportation. They planned to extend to support other transport such as cycling, taxi, etc.

IV. Conclusion

This literature review shows the classifications of mobile recommender systems for the tourism traveling. Three groups was built based on the content (only give information or information and routing), type of transportation (single or multi mode transportation), and the source of information (from the users or collaborative, from the administrator, or both of them). Each group has the purposes and every application try to be the most adaptive recommender systems for the tourist needs. For the lack from the existing researches, recommender system needs the more environment friendly device using the efficient power, longer battery and wireless technology. The future application need faster algorithm, more specific model and can handle enormous dynamic data. Another tourist needs is considering additional aspect like budget, break time and scenic path. Eventually, the recommender system needs an efficient and effective way to be more customizable with the tourist conditions.

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<tr><th></th><th>24 July 2017</th><th>25 July 2017</th><th colspan="2">26 July 2017</th><th>27 July 2017</th></tr>
<tr><td>08:00-08:30</td><td rowspan="11"></td><td>Registration</td><td colspan="2"></td><td rowspan="20">Social Activities</td></tr>
<tr><td>08:30-09:00</td><td rowspan="3">Opening Ceremony</td><td colspan="2" rowspan="3">ICALT Tutorial : Prof Aref Maalej</td></tr>
<tr><td>09:00-09:30</td></tr>
<tr><td>09:30-10:00</td></tr>
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<tr><td>10:30-11:00</td><td rowspan="3">Plenary Lecture 1: Prof. Benyamin Kusumoputro
Plenary Lecture 2: Prof. Thomas Goldsby</td><td rowspan="3">QIR SESSION</td><td rowspan="3">QIR SESSION</td></tr>
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<tr><td>15:30-16:00</td><td rowspan="4">QIR SESSION</td><td rowspan="4">ICALT SESSION 3- ITS</td><td rowspan="4">ICALT SESSION 4-LSCM</td></tr>
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<tr><td>18:00-18:30</td><td rowspan="2">Poster Session</td><td rowspan="2">Poster Session</td><td rowspan="2">Poster Session</td></tr>
<tr><td>18:30-19:00</td></tr>
<tr><td>19:00-21:00</td><td>Gala Dinner</td><td colspan="2">Networking Dinner & Closing Ceremony</td></tr>
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IEEE ICALT'2017 session details						
	id	Title	Authors	Organization	Country	Date
ICALT SESSION 1 (01.00-03.00 pm) (Room 1)-OLC						
Co-Chairs : Hakim Artiba (University of Valenciennes, France) & Cindy Priadi (University of Indonesia, Indonesia)						
01.00 pm	OLC45	Multi-Criteria Decision Making framework for selecting distribution strategy in E-Commerce	Sumit Sakhuja, Giuseppe Timperio, **Lindawati** and Robert de Souza	National University of Singapore	Singapore	26/07/2017
01.15 pm	QR106	The Effectiveness of Pilot Marine Transport Services for Goods Distribution in Maluku Island Group, Indonesia	**Windra Priatna Humang,** Sigit Pranowo Hadiwardoyo and Nachry Yusuf	University of Indonesia	Indonesia	
01.30 pm	OLC30	Cooperative Tabu Search for NP-Hard Combinatorial Problems: Application to the Traveling Salesman Problem and the Integrated Problem of Location Assisgnment and Straddle carrier Scheduling	**Hamdi Dkhil**, Adnan Yassine and Habib Chabchoub	University of le Havre	France	
01.45 pm	QR216	The Hybrid Clustering Heuristic Approaches to Solve Capacitated Facility Location Problem	Gerard Randi Sutanto, Sunho Kim and **Hadi Sutanto**	University of Indonesia	Indonesia	
02.00 pm	QR228	The Layout Optimization of Production Process Facilities in Apple Processing to Improve Productivity and Sustainability SMEs	**Debrina Puspita Andriani,** Muhammad Hafid Zamroni, Tiffany Clara Alesi and Fajri Rahman	University of Indonesia	Indonesia	
02.15 pm	OLC 6	Impact of modal shift of container transportation from Urban Highways: In the context of Colombo metropolitan	**Punthila Erandi Jayarathne**	University of Moratuwa	Sri Lanka	
02.30 pm	QR415	Container Ship Accident Analysis Due To Container Stacked On Deck As An Attempt To Improve Maritime Logistic System	**Gafero Rahim** and Sunaryo Sunaryo	University of Indonesia	Indonesia	
02.45 pm	OLC46	Stakeholders' Needs and Requirements from a Decision Support System for Staff Scheduling in the Road Transportation of Crude Oil Sector	**Koubaa Mayssa**, Souhail Dhouib and Abderrahman El Mhamedi	University of Paris 8	France	
ICALT SESSION 2 (01.00-03.00 pm) (Room 2)-EI						
Co-Chairs : Aref Maalej (University of Paris 8, France) & Komar Udin (University of Indonesia, Indonesia)						
01.00 pm	QR26	The Implementation of Wash, Rinse, and Spin Technique in Accelerometer's Data Processing on Android Smartphone to Generate Stream Keys	**Danila Machmud** and Dion Ogi	University of Indonesia	Indonesia	26/07/2017
01.15 pm	QR57	Study Trends and Challenges of the Development of Microgrids	**Heri Suyanto a**nd Rina Irawati	University of Indonesia	Indonesia	
01.30 pm	QR161	Review on The Development of Ride Sharing System Using Online Transportation Service in Jakarta	**Helen Burhan**, Sutanto Soehodho and Nahry Yusuf	University of Indonesia	Indonesia	
01.45 pm	IE28	The Development of Sustainability Strategic Management Assessment Tool (From a Systematic Literature Review to a Conceptual Framework)	Yenny Sari and **Akhmad Hidayatno**	University of Indonesia	Indonesia	
02.00 pm	IE32	Simulating impacts of regulatory policies on urban freight: application to the catering setting	**Sarra Jlassi,** Simon Tamayo, Arthur Gaudron and Arnaud De La Fortelle	MINES ParisTech	France	
02.15 pm	IE41	Importance of Handling Resources' Incorporation Into Simulation Expert System Approach	**Imen Lajmi,** Wassim Masmoudi and Mounir Elleuch	University of Sfax	Tunisia	
02.30 pm	QR131	Reducing MSDS Using Anthropometric Design at Small and Medium Printing Enterprise	**Meilita Tryana Sembiring**, Irwan Budiman and Yusuf Hanifiah	University of Indonesia	Indonesia	
02.45 pm	IE8	Supply chain improvement in LARG (Lean, Agile, Resilient, Green) context: A Risk Management Approach	**Rachid Benmoussa**	University of University Cadi Ayyad	Morocco	
03.00 pm	IE18	Elaboration of Risk Mitigation Strategies based on Sustainable Development Practices	**Manel Elmsalmi,** Hayfa Khlifi and Wafik Hachicha	University of Sfax	Tunisia	

ICALT SESSION 3 (03.30-06.00 pm) (Room 1) ITS						
Co-Chairs : Bertrand David (Ecole Centrale de Lyon, France) & Rachida Benmoussa (University of University Cadi Ayyad, Morocco)						
03.30 pm	ITS 1	Acquisition of Automated Guided Vehicle Route Planning Policy Using Deep Reinforcement Learning	**Ryota Kamoshida** and Yoriko Kazama	Hitachi, Ltd.	Japan	26/07/2017
03.45 pm	ITS2	Optimizing V2X Data Collection and Storage for a Better Cost and Quality Trade-off	**Mohamed Ben Brahim and Hamid Menouar**	Qatar Mobility Innovations Center	Qatar	
04.00 pm	ITS3	Robust Operation of Autonomous Logistics Vehicles in Intelligent Warehouse	Boc Minh Hung, **Sam-Sang You,** Hwang-Seong Kim and Bui Duc Hong Phuc	Korea Maritime and Ocean University	South Korea	
04.15 pm	ITS13	A Pool-based Recursive Construction Approach for Logistics Route Planning with Time Window	Ya-Wen Yang and **Hsueh-Chan Lu**	National Cheng Kung University	Taiwan	
04.30 pm	ITS31	Fresh and Frozen Foods Lockers as part of Market, e-Market and Collaborative Economy Smart City Environment: Systemic & logistic point of view	**Bertrand David** and René Chalon	Ecole Centrale de Lyon	France	
04.45 pm	ITS35	Material supply by means of multi-load autonomus robots	Augusto Urru, Marco Bonini and **Wolfgang Echelmeyer**	Reutlingen University	Germany	
05.00 pm	ITS40	On the Design of a Safety Related Middleware DDS Application for Underground Railway Environment	**Seilendria Ardityarama Hadiwardoyo** and Liuhua Gao	Universitat Politecnica de Valencia	Spain	
05.15 pm	QR830	Vehicle Detection using Dimensionality Reduction based on Deep Belief Network for Intelligent Transportation System	Dewa Made Sri Arsa, Grafika Jati and Wisnu Jatmiko	University of Indonesia	Indonesia	
05.30 pm	ITS33	Big Data for Operational Efficiency of Transport and Logistics : A Review	Tawfik Borgi, Nesrine Zoghlami, Mourad Abed and Mohamed Saber Naceur	University of le Havre	France	
05.45 pm	QIR537	LEAN WAREHOUSING IMPLEMENTATION FOR PROCESS IMPROVEMENT ON 3PL WAREHOUSE	Rahmat Nurcahyo and Enggar Cesarini	Universitas Indonesia	Indonesia	
ICALT SESSION 4 (03.30-06.00 pm) (Room 2) LSCM						
Co-Chairs :Thomas J. Goldsby (Fisher College of Business, USA) & Tri Tjahiono (University of Indonesia, Indonesia)						
03.30 pm	LSCM3	Finding an Optimal Assignment of Berths Containers to Storage Areas in port Terminals Formulation, Complexity and Case Study	**Lobna Kallel,** Hichem Kamoun, Mounir Benaissa and Abdellatif Benabdelhafid	University of Sfax	Tunisia	26/07/2017
03.45 pm	LSCM11	Load and drive method for cargo securing on commercial vehicles	**Marc Juwet** and Niek Cherlet	KU Leuven	Belgium	
04.00 pm	LSCM16	Forecasting Supply in Voronoi Regions for App-Based Taxi Hailing Services	**Ravina Gelda,** Krishna Jagannathan and Gaurav Raina	Indian Institute of Technology Madras	India	
04.15 pm	LSCM22	Contemporary Issues in The Indonesian Fish Logistics	Danang Parikesit, **Hafida Fahmiasari** and Setijadi	The World Bank	Indonesia	
04.30 pm	LSCM23	Estimation of Travel Time Variability Using Bus Probe Data	**As Mansur** and Tsunenori Mine	Kyushu University	Japan	
04.45 pm	LSCM26	Tourism Mobile Recommender Systems: A Survey	**Indri Hapsari** and Isti Surjandari	University of Indonesia	Indonesia	
05.00 pm	LSCM27	Airline Cargo Alliance and Allied Flight Frequency Analysis using the Fuzzy Cooperative Game and Flight Frequency Programming	**Yuh-Horng Wen**	Tamkang University	Taiwan	
05.15 pm	LSCM39	Utilizing Excess Capacity in Last Mile Using 4th Party Milk Run	Cher Kian Lee, **Lindawati Lindawati** and Robert de Souza	National University of Singapore	Singapore	
05.30 pm	QR26	Model of Governance Management and Port Performance Improvement Strategies in Indonesia	**Sirajuddin,** T. Yuri Zagloel and Sunaryo	University of Indonesia	Indonesia	
05.45 pm	LSCM14	A typology of dashboard for a territorial industrial ecosystem	Ebtissem Sassi, **Abdellatif Benabdelhafid** and Sami Hammami	University of le Havre	France	

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