Acceptance of the Improvement on Mobile Application

A Study on User Engagement of a Highway Concessionary in Malaysia

Aziza Isnoor Ishak
Malaysian Institute of Information Technology (MIIT)
Universiti Kuala Lumpur (UniKL)
Kuala Lumpur, Malaysia
isnoor_azie93@yahoo.com

Shahrinaz Ismail
Malaysian Institute of Information Technology (MIIT)
Universiti Kuala Lumpur (UniKL)
Kuala Lumpur, Malaysia
shahrinaz@unikl.edu.my

***Abstract*—Challenges in the change of technology in recent years have affected highway concessionary companies in Malaysia. The change of direction in the company have put this research forward in looking at the aspect of user engagement via the usage of mobile application. It is proposed that the features in the current mobile application are to be improved in order to let the users, especially young drivers who are growing in numbers, feel more engaged to the services and management of the highway operations. Having said this, the objectives of this research are to gauge young drivers' expectation on features in mobile application, and to analyse the acceptance of the prototype with the improved mobile application. Two surveys were conducted to meet these two objectives, both with respondents under the category of young drivers between the ages of 20 to 35. Better insight on what are desired by the respondents is found and presented in this paper, with suggestions on further improvement for future work.**

Keywords—mobile application; highway concessionary; technology acceptance model; features usability

I. INTRODUCTION

With the recent challenges in economy and organisation restructure, the leading highway concessionary in Malaysia is looking into user engagement. Since the growing number of vehicle drivers and mobile phone users are young drivers between the ages of 20 to 35, a study is called upon to be conducted to understand their expectations on the mobile application developed by the highway concessionary.

PLUS Expressways, or PLUS Malaysia Berhad, is the largest highway concessionary or build-operate-transfer operator company in Malaysia [1]. It became the holding company of multiple concessionaries other than PLUS, like ELITE, Linkedua and KLBK. In fulfilling the company mission of "providing efficient and safe expressway network that enhances quality of life" [1], PLUS have invested on technology to ease the operations at the entrance and exits of highways, i.e. toll plazas, among other operations. From the PLUSMiles and Touch 'n Go system to SmartTag system, PLUS has expanded its customer service to the PLUSMiles mobile application called PLUS Expressways.

Despite the growing numbers of PLUS daily users, not many of them know about the PLUS Expressway application and the benefits of PLUSMiles card. Drivers mainly use the card to pay the toll and use the highway (and other facilities that are allowed to be paid using the card). Little that they know that the card comes with toll rebate rewards, discount and privileges. Hence the need to investigate the current situation of the highway users.

This research aims to understand the current highway usage by drivers in Malaysia, by taking the sample of young drivers that comprises the majority of highway users. In order to meet this aim, the research objectives are to:

- gauge young drivers' expectation on features in mobile application; and
- analyse the acceptance of the prototype with the improved mobile application.

II. RELATED WORKS

A. Transportation and Road Users in Malaysia

In becoming a developed nation, the government of Malaysia intends to provide a range of comprehensive public transport system to meet the needs of the people. According to the statistics of the Ministry of Transport, at the moment only 16 percent of the population of the Klang Valley is using the public transport system [2]. So, the government has targeted that this percentage would be increased to 25 percent at the end of 2012. Having said this, an additional of 35 set "4-car-trains" were installed to operate for the Kelana Jaya LRT line at the end of 2012, showing that the government has shown its seriousness in the NKRA to improve public transport. It aims to facilitate the people to enjoy the services of a systematic public transport. The important thing here, people were asked to leave private cars and start using public transport [2].

Despite the hype, the low percentage of population using public transports (i.e. hardly reach 30%) shows the consistently

huge number of road users who prefer to drive, regardless of the government efforts in investing on the facilities upgrading. This results in a consistently increasing number of accidents in Malaysia.

> *"Between 2004 and 2014 there is an increase of 82 percent in the number of vehicles registered in the country compared to 18 percent increase in the nation's population within the same period. Road accident has raised by about 42 percent within the last decade with the number of deaths for the year 2014 recorded at 6,674. Road traffic fatality per 100,000 population for Malaysia stands at 24 compared to the global average of 17.4." [3]*

In addition to the quoted report above, road accidents do not only happen on urban roads, but also on highways or expressway, where the speed limit is more. If not well managed, an accident could cause hours of traffic congestion on the highway, especially for a journey that may not have any exit in the span of many kilometres away. One of the examples is a traffic congestion that spanned 12 kilometres near the Menora Tunnel in Perak, happened in December 2016 due to an accident involving an oil tank truck at the north bound Kilometre 256.5 PLUS North-South Expressway (NSE) [4]. Another accident happened a year after that incident, at the south bound traffic on the PLUS North-South Expressway (NSE) involving a tanker lorry carrying liquid acid and a car at Kilometre 256 near Senawang toll [5]. Highway users could not escape the route and they were stuck for hours. Hence the need for prevention and better user engagement by the highway concessionary.

B. Highway Concessionary

As mentioned in previous research, Project Lebuhraya Utara-Selatan Berhad (PLUS) is the concessionaire for the activities of carrying people and freight starting from the Thai border at the north of Peninsular Malaysia to the Causeway to Singapore in Johor Bahru, by way of Kuala Lumpur and other major conurbations. The main job for PLUS is to "design, build finance and operate the road network to serve the needs of the Malaysian people" [6]. In other words, it is expected that the concessionaire ensures that a reasonable level of service is constantly and continuously maintained along the built expressway.

Nevertheless, there is a decline in serviceability of the concessionaire due to the action of traffic and environment parts of the expressway. It is part of the job to monitor this decline and continually propose logical solutions to maintain the serviceability level at a satisfactory state, i.e. at the minimum disruption to the users, without placing undue financial burden on road users [6].

On the other hand, highway concessionary is not just about maintaining the approximately 30% concrete and 70% asphaltic pavements that makes up about 900 kilometres of roadway, or 1800 carriageway-kilometres [6], but also about the services the company could provide to the users along the way through their journey. Having said this, PLUS established subsidiary companies like Teras Technology Sdn Bhd (TERAS), which is the IT arm who developed the Touch 'n Go system, and PLUS Helicopter Services Sdn Bhd (PHS), which supports PLUS in monitoring the traffic on the highway and for emergency case logistics [1]. They are also the substantial shareholder of Touch 'n Go Sdn Bhd. For support services, PLUS provides PLUSRONDA, Traffic Monitoring Centre and Reload lanes to ensure that consumers experience smooth journey [1]. PLUS also have mobile application known as PLUS Expressways, which is developed by an external vendor called AVIVEN.

C. Mobile User Engagement

With the recent trend of mobile smartphone usage with location-based applications, users experience a variety of experiences that would compel them "to continuously engage in activities that create value and satisfaction" [7]. The concept of continuous engagement in mobile technology is not far from the concept of technology acceptance, yet the latter is considered the starting point of technology engagement. Although overlapped, the terms technology acceptance and technology engagement are different in definition, conceptual foundation and application [7]. "Acceptance generally refers to the stage in which something (e.g. a smartphone) is selected for use by an individual or any organisation while engagement refers to the state of being involved, occupied, retained and intrinsically interested in something" [8].

For the case of mobile technology, it should not only be usable to the users, but it should engage users [7], because there is a strong connection between engagement and profitability through customer satisfaction and increased sales [9], among others. With the increase of users' engagement, by providing an environment that fit the purpose of fostering engagement, then it would significantly increase the success in business. Engagement in mobile technology and its ubiquitous service drives value and satisfaction which can lead to future loyal users [10].

According to Attfield, Kazai and Lalmas [11], user engagement is "the emotional, cognitive and behavioural connection that exists, at any point in time and possibly over time, between a user and a resource". This definition is derived from earlier argument by Jacques et al. (1995) who explained that users' engagement experience are "feelings that their interests have been captured and attracted by the system for their internal rewards" [7]. It is about the state of interaction with technology application that makes the users want to use it. Previous researchers talked about engaging interactions that involve functionality, apart from attention, intrinsic interest, interactivity, perceived control and choice, and motivation [12], which are derived from studies across domains.

In today's world, with users more knowledgeable day by day, they make choices on technologies to invest their time, effort and money in based on how they make them feel [12]. Hence, it is not about whether the application is efficient, effective of satisfying anymore, but how well it is able to engage users and provide them with an experience [13]. The experience include system features that facilitate positive user experiences, which can be applied in the design of the technology [14], which in turn will enable the business competitive success.

A proposed model introduced by Kim, Kim and Wachter [7], called the mobile user engagement (MoEN) model, is meant for

general mobile device usage, and not for particular mobile applications. Since it is more general than the original technology acceptance model (TAM) [15], it is believed that TAM is more relevant to be used in this research to evaluate the perceived usefulness of the improved features in the mobile application under study.

D. Smartphone usage in Malaysia

The penetration rate among daily Internet usage over smartphones in Malaysia has increased to 63 percent in 2015 compared, to only 47 percent in 2012. Ericsson Chief ComsumerLab Southeast Asia and Oceania, Afrizal Abdul Rahim, said that the main drive for consumers to buy smart phones is to connect and use the Internet. Last year, more use of smart phones to social networks, but this year is the instant messaging (IM) and presence services in a market such as this [16]. The same news reported that the ownership of smartphones has increased 16 percent to 63 percent this year, with 17 percent of respondents said that they bought a smartphone in the past six months [16].

"Mobile data services are experiencing impressive growth among smartphone users, especially for instant messaging, social networks and video games. The analysis also found that the use of applications has soared to 76% compared to 54% the year before. Short message services (SMS) and the Internet show a large increase among smartphone users in the country. Based on data gathered from a worldwide network, the institute predicts the number of smart phones is greater. Subscribed smartphones in 2018 is now forecasted to reach 4.5 billion compared to the forecast in November 2012 giving a total of 3.3 billion [16].

The following news in 2013 stated that 29 percent (29%) of students in Malaysia access the Internet using smartphones, followed by another 23 percent (23%) using mobile phones [17]. Among these figures include young drivers in Malaysia. In 2014, the number of sales on smartphones in Malaysia increased 42 percent (42%) from the year before, in which 4.8 million smartphones and 900,000 tablets imported in to Malaysia within half a year of 2015 [18]. Two years after that, it is reported that Malaysians spent RM 6.8 billion for smartphones, from the data gathered from March 2016 to February 2017 [19].

> *"Smartphones were the most commonly owned Internet access device among all Internet users in Malaysia. The percentage of smartphone ownership rose from 74.3% in 2014 to 90.7% in 2015 … While smartphone remained the most popular means for people to access the Internet (89.3%), 46.0% said they used netbook/notebook/laptop to go online as well. [20]*

From the news and reports since 2012, it is proven that the number of Internet users via smartphones is increasing every year. Hence the need to improve the services provided through mobile applications for better user engagement.

III. METHODOLOGY

Two questionnaire surveys were implemented to capture: i) the expectations of young drivers on the highway concessionary mobile application; and ii) the acceptance of improvement made on the mobile application features. The target respondents are young drivers in Malaysia from the age of 20 to 35 in majority (i.e. university students), in which online survey was chosen to reach them. The distribution of the first survey spanned from December 2016 to March 2017, taking a longer time than the expected duration due to the difference in academic calendar among universities in Malaysia.

The distribution of the second survey took only a week, in which the respondents were approached personally within the vicinity of the research location (i.e. Kuala Lumpur), and the prototype of the improved mobile application was demonstrated to them before they answered the survey. Table 1 shows the research settings for both surveys.

TABLE I. RESEARCH SETTING

Survey	Purpose	Questionnaire Distribution		
		Duration	***Approach***	***Respondents***
Survey I (Before)	Analyse the mobile application usage among young drivers; Gauge young drivers' expectation on features in mobile application	4 months	Online, self-administered	196 students from 6 institutes of higher learning
Survey II (After)	Analyse the acceptance of the prototype with the improved mobile application	1 week	Researcher administered	30 respondents from PLUS Berhad employees and users

A. Mobile Application Usage and Users' Expectations

The questionnaire for Survey I (as mentioned in Table I) consists of three sections: (i) demographic information including driving/riding frequency, highways usage and ownership of mobile phone/device with Internet access; (ii) mobile phone and application usage including usage frequency of mobile applications related to highways and journey planning; and (iii) improvement on PLUS Expressways application and users' expectations on the improvements. This survey served as the data collection for user requirement of this research.

B. Acceptance of the Improved Mobile Application

The Survey II questionnaire is mainly to get feedbacks on the evaluation of the improvements made on PLUS Expressways features, based on the Technology Acceptance Model (TAM) by Davis [15] and features usability criteria. The questionnaire is designed to consist 3 sections: (i) demographic information; (ii) technology acceptance; and (iii) features usability. The respondents include PLUS Berhad employees and PLUS highway users.

IV. DATA ANALYSIS

This section covers the analysis on both surveys mentioned in section III. The presentation starts with the validity and reliability tests performed on questionnaire Survey II, followed

by the results analysed using Statistical Package for the Social Sciences (SPSS).

A. Validity and Reliability

Since the questions in Survey I do not include feedback options in the form of Likert scales, the validity test is performed only on questionnaire data of Survey II using factor analysis in SPSS. The total number of respondents (n = 30) is found valid in factor analysis test, with all items in each variable having high communality values above 0.400. The value of 0.500 and above shows that the sample size is enough for further analysis, whereas small values below 0.400 means that the variables do not fit well with the factor solution [21].

In terms of reliability, the Cronbach's alpha reliability coefficient (α) is measured using SPSS. The values derived from this measurement bring different meaning according to the following range: $\alpha > 0.900$ is excellent; $0.800 < \alpha < 0.899$ is good; $0.700 < \alpha < 0.799$ is acceptable; $0.600 < \alpha < 0.699$ is questionable; $0.500 < \alpha < 0.599$ is poor; and $\alpha < 0.500$ is unacceptable. For this study, the acceptable value for Cronbach's alpha (α) is from 0.700 onwards, considering that 0.700 is the starting value for being acceptable.

The result in Table II shows that all variables in the questionnaire Survey II on technology acceptance and features usability sections are reliable, with all α values more than 0.700, except for behavioural intention (α = 0.643). Attitude and features usability variables hold the highest reliability values (α = 0.905 and α = 0.927 respectively) even though they consist the most number of items.

TABLE II. RELIABILITY OF QUESTIONNAIRE DESIGN FOR SURVEY II (N = 30)

Variable	Cronbach's Alpha (α)	Number of Items
Technology Acceptance		
Perceived usefulness (PU)	0.864	3
Perceived ease of use (PEOU)	0.860	3
Attitude (ATT)	0.905	5
Behavioural Intention (BI)	0.643	3
Perceived Usage (SU)	0.783	2
Features Usability		
Features Usability (FE)	0.927	8

B. Results from Questionnaire Survey I

The third section of questionnaire Survey I gathered the agreement on the recommended features for the improved mobile application, based on "yes" or "no" answers. The number of recommended features is 13 including "others". Figure 1 shows the result from this section, omitting out the "others" due to no response on this option.

In general, Figure 1 shows that most respondents, i.e. young drivers in Malaysia (n = 196), agreed for the mobile application to include the "real-time suggestion on route to avoid traffic jam" (50.51%). This feature is perceived as a must for the mobile application, due to the minimum availability of similar applications that provide services to plan one's journey, such as Waze™ and Google™ Map™. The second highest recommendation is on "more information on the rest and service areas" (49.49%), regardless of the information provided in the current features in PLUS Expressways that include live video camera on the rest and service areas.

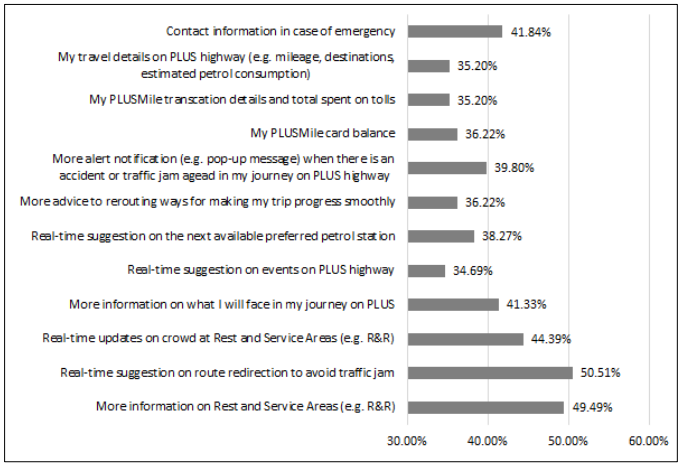

Fig. 1. Recommended features for the improved mobile application (n = 196)

On the other hand, although PLUS Berhad has a good intention to engage more with the highway users, especially young drivers, Figure 1 shows that the respondents may not feel the same, giving a result of the lowest agreement on the recommendation to have "real-time suggestion on events on PLUS highway" (34.69%). It is a close value compared to the other two lowest percentages: "my PLUSMile transaction details and total spent on tolls" (35.20%); and "my travel details on PLUS highway (e.g. mileage, destinations, estimated petrol consumption)" (35.20%).

C. Results from Questionnaire Survey II

Figure 2 shows the average value on the agreement level derived from the 5-Likert scale of the technology acceptance section in Survey II. The value options in the questionnaire are: 1 for totally disagree; 2 for disagree; 3 for neutral; 4 for agree; and 5 for totally agree.

From the chart shown in Figure 2, all responses returned with the averages between 4.00 and 4.28, proving that all respondents agree to the statements based on TAM. The highest average value is 4.28 on the statement "Overall, this app is easy to use", whereas the lowest average score is on the statements "All things considered, I accept to continue using this app during my journey on PLUS highways" and "It is desirable to use this app to know the updated accident alert and traffic info on PLUS highways" (average = 4.00).

The highest agreement is for a statement that is generally constructed. On the other hand, the lowest agreement shows that the respondents could be slightly doubtful on whether they will use the improved mobile application.

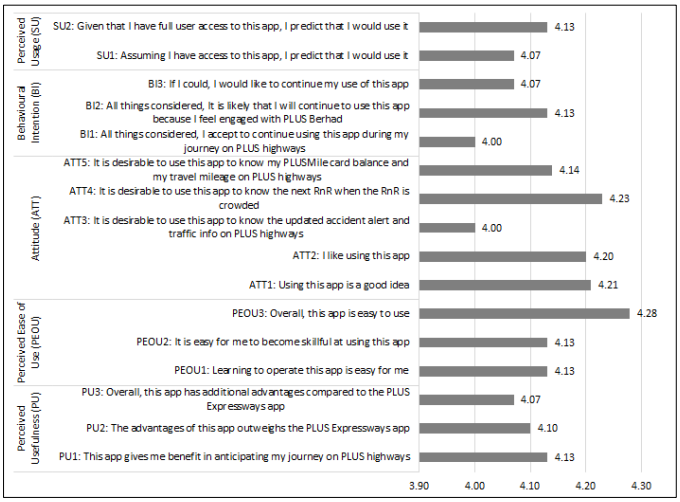

Fig. 2. Agreement on the improved application acceptance (n = 30)

Figure 3 shows the results from the features usability section in Survey II. The question type is the same as the previous section, i.e. 5-Likert scale of agreement on the given statements. As stated in Table II, there are eight items or statements for the respondents to agree on, with the same value options mentioned in the previous section.

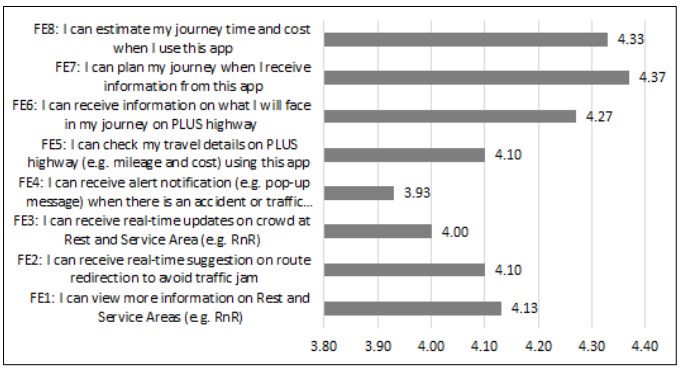

Fig. 3. Agreement on the features usability (n = 30)

As shown in Figure 3, respondents general agreed to the usability of all features provided in the improved mobile application. The highest value received is 4.37 for the statement "I can plan my journey when I receive information from this app". On the other hand, the lowest value is 3.93 for the statement "I can receive alert notification (e.g. pop-up message) when there is an accident or traffic jam ahead in my journey, when I touch my PLUSMile card at the plaza toll upon entering the PLUS highway". Even though this latter statement complements the former one, it receives the lowest agreement value, which is below 4.00.

V. Discussions

Interesting results are retrieved from Survey I, giving the fact that the expectation of having mobile application features that would make the young drivers feel more engaged to the highway concessionary seems to be a one-way good intention. As mentioned in the previous section, the respondents are looking forward to have features that are considered minimum requirement in current applications, such as real-time suggestion on route redirection (50.51% in Figure 1). Shown in the same Figure 1, high recommendations to have more information on rest and service areas (49.49%) and updates on the crowd at rest and service areas (44.39%) shows that the current information received along the highway may be insufficient to the drivers. It also shows that by knowing ahead on the situation at the rest and service areas would make the drivers more alert and thoughtful in planning during the journey. It would also avoid them from wasting time turning in to the rest and service areas only to find no available parking. Time is of essence for young drivers.

The results from Survey II complements these findings, in which the respondents agreed that they could plan their journey when they receive ample information from the proposed application (FE7 average = 4.37). This supports the feedback on how they could estimate their journey time and cost (FE8 average = 4.33). As a result, the overall improvement made in the proposed application is accepted, with respondents finding that the application is easy to use (PEOU3 average = 4.28) and using the application is a good idea (ATT1 average = 4.21).

One limitation found on the proposed mobile application is having alert notification (e.g. pop-up message) when there is an accident or traffic jam ahead one's journey (FE4 average = 3.93). Even though the respondents agreed that they could use the application to know if the next rest and service area is crowded or not (ATT4 average = 4.23), quite a low agreement is received on using the application to know updated accident alert and traffic information (ATT3 average = 4.00). This may due to lack of information shown in the prototype. It is recommended that instead of a pop-up message, a voice alert notification could be more practical and manageable for drivers on highway. In addition to that, having a voice message would make the users feel more engaged and alert while driving.

VI. Conclusion

Overall, young drivers' expectation on features in mobile application is captured in Survey I, as well as their acceptance of the improved mobile application is successfully analysed, in this research. However, improvements should be made on the features in the proposed mobile application, to let the users feel that they receive ample information that could help them prepare in facing their journey on PLUS highway (FE6 average = 4.27).

It took almost a year to conduct this research, in which the improvements were slowly made on the PLUS Expressways application by the hired vendor. Nevertheless, the feedbacks from this study are deem important to show how engaged users would feel when using the application, as well as whether they want to be engaged with the highway concessionary. Future work is recommended to look into a more detail research, with in-depth analysis on usability of mobile application reflecting user engagement, with more possible variables to be proposed as extension to the technology acceptance model.

Acknowledgment

We would like to acknowledge Norizah Hanim Shaari from the Strategic Marketing Department and Yusuf Abdul Aziz from

the Northern Region Management of PLUS Malaysia Berhad (PLUS) for the opportunity to explore this study.

REFERENCES

[1] PLUS Malaysia Berhad (PLUS). PLUS: A Member of UEM, 2014

[2] Jabatan Kerja Raya (JKR), "NKRA: Mempertingkatkan Pengangkutan Awam di Bandar," Sistem Pembangunan Awam Menjana Pembangunan Negara, 2016.

[3] N. Danlami, M. Napiah, A.F.M. Sadullah, and N. Bala, "An Overview and Prediction of Malaysian Road Fatality: Approach using Generalised Estimating Equations", International Journal of Civil Engineering and Technology (IJCIET), vol. 8, no. 11, 2017, pp. 452-465.

[4] "Tanker lorry crash causes traffic congestion near Menora Tunnel", The Sun ePaper [Ipoh] 10 Dec 2016.

[5] "Traffic congestion on North-South Expressway following acid tanker-car crash", Malay Mail Online [Seremban] 12 Aug 2017.

[6] S.B. Costello, M.P.N. Burrow, A. Ourad, and M.S. Snaith, "An Integrated Management Approach to the Maintenance of Toll Roads in Peninsular Malaysia", 6th International Conference on Managing Pavements, 2004.

[7] Y.H. Kim, D.J. Kim, and K. Wachter, "A study of mobile user engagement (MoEN): Engagement motivations, perceived value, satisfaction, and continued engagement intention", Decision Support Systems, vol. 56, 2013, pp. 361-370.

[8] M. Pagani, and A. Mirabello, "The influence of personal and social–interactive engagement in social TV web sites", International Journal of Electronic Commerce, vol. 16, no. 2, 2011, pp. 41–68.

[9] J.K. Harter, F.L. Schmidt, and T.L. Hayes, "Business-unit-level relationship between employee satisfaction, employee engagement, and business outcomes: a meta-analysis", Journal of Applied Psychology, vol. 87, no. 2, 2002, pp. 268–279.

[10] J. Revels, D. Tojib, and Y. Tsarenko, "Understanding consumer intention to usemobile services", Australasian Marketing Journal (AMJ), vol. 18, no. 2, 2010, pp. 74–80.

[11] S. Attfield, G. Kazai, and M. Lalmas, "Towards a science of user engagement (Position Paper)", ACM WSDM'11, Hong Kong, 2011.

[12] H.L. O'Brien, and E.G. Toms, "The Development and Evaluation of a Survey to Measure User Engagement", Journal of the American Society for Information Science & Technology, vol. 61, no. 1, 2010, pp. 50-69.

[13] L. Bannon, "A human-centred perspective on interaction design", in A.Pirhonen, H.Isomäki, C.Roast, & P.Saariluoma (Eds.), Future Interaction Design. Berlin, Germany: Springer, 2005, pp. 9–30.

[14] G. Lindgaard, "Adventurers versus nit-pickers on affective computing. Interacting with Computers", vol. 16, 2004, pp. 723–728.

[15] F. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of Information technology", MIS Quarterly, vol. 13, no. 3, 1989, pp. 475-87.

[16] "Pemilikan telefon pintar meningkat 63%," Utusan Online [Kuala Lumpur] 4 Sep 2013.

[17] K. Yahaya, "29 peratus pelajar akses Internet guna telefon pintar," Utusan Online [Kuala Lumpur] 14 Nov 2013.

[18] "Jualan telefon pintar, tablet di Malaysia naik 42%," Utusan Online [Kuala Lumpur] 8 Sep 2015.

[19] "Rakyat Malaysia belanja RM6.8 bilion untuk telefon pintar", Utusan Online [Kuala Lumpur] 6 Jul 2017.

[20] Malaysian Communications and Multimedia Commission (MCMC), Internet Users Survey 2016: Statistical Brief Number Twenty, 2016. ISSN: 1823-2523.

[21] S. Ismail, M.S. Ahmad, and Z. Hassan, "Regression analysis on agent roles in personal knowledge management processes: Significance of a connect agent in mediating human's personal knowledge management", IEEE 8th International Conference on Information Technology in Asia (CITA), 2013, pp. 1-8.