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A Dynamic Investigation of iBeacon Adoption at Tourism Destination

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관광지에서의 iBeacon 도입에 대한 동태적 분석

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요 약 모든 사물들이 연결되고 있으며 계속 확장되고 있다. 예를 들어, BLE (Bluetooth low energy) 비콘은 인접한 수신기에 식별 신호를 보내고 근접 마케팅부터 실내형 위치기반서비스에 이르는 다양한 응용프로그램을 개발할 수 있는 무선통신기술이다. 스마트 관광 분야의 최신 기술 중 하나인 iBeacon은 관광지에서의 방문 경험을 향상시키는 데 매우 유용한 것으로 알려져 있으나 이와 관련한 학술연구는 많지 않다. 본 연구는 관광지에서 iBeacon이 채택되는 과정을 분석하기 위해 주요 영향요인의 상호 관계 및 피드백 구조를 조사하였다. 연구목적을 달성하기 위해 본 연구는 시스템 다이내믹스 방법을 이용하여 관광지에서 iBeacon 채택의 동태적 모형을 개발하였다. 분석 결과, '사회적 영향'의 개념이 관광객의 iBeacon 수용의도에 대한 중요한 예측 요인 중 하나이며, 구전효과, 주관적 규범, 프라이버시 그리고 인지된 유용성이 iBeacon 채택에 영향을 미치는 핵심 요소인 것으로 나타났다.

키워드 : 스마트 관광, 시스템 다이내믹스, 시스템 사고, 인과고리지도, 아이비콘, 구전효과, 사회적 영향

Abstract The interconnectedness of all things is continuously expanding. For example, bluetooth low energy (BLE) beacons are wireless radio transmitters that can send an identifier to nearby receivers and trigger a number of applications, from proximity marketing to indoor location-based service. iBeacon technology which is one of the newest technologies in the smart tourism field, is reckoned as being very useful for travelers in enhancing the experience with visiting places. However, there is consequently not much existing research yet about the connection between iBeacon technology and tourism destination. Considering that, this study analyzes the adoption of iBeacon in tourism destination, this study examine the interrelationships and feedback structures of key factors in iBeacon adoption. To serve the purpose, this study used system dynamics approach to develop a model of iBeacon adoption in tourism destination. The analysis results showed that the concept of 'Social Influences' is one of the significant predictors for individual's intention behavior to accept iBeacon, and word of mouth (WOM), subjective norm, privacy concern, and perceived usefulness are key factors influencing the iBeacon adoption.

Key Words : Smart Tourism, System Dynamics, Systems Thinking, Causal Loop Diagrams, iBeacon, Word of Mouth (WOM), Social Influence

1. Introduction

Tourism industry with its rapid growth has become one of the biggest industries in the world

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which has a direct impact on economic, environmental and social aspects. Tourism industry is recognized as one the major economic driving forces which contributes to job creation and generating income. Up until now, several studies have considered determinants of technology acceptance in tourism destinations. [1] give a holistic look to smart tourism by considering it as a complex and dynamic ecosystem and emphasizes on the inter-connectivity of the whole system. In this vein, with the emergent context of travel, the main concern for smart destinations is to determine tourism experience throughout mobile surroundings [2]. Given the hyper-local and contextual capabilities of beacons, they are of immense value to both travelers as well as players in the tourism industry. Over 70% of the global population today use mobile phones and these gadgets can prove to be very nifty while travelling. Given the proliferation of mobile phones, wearable and the power of beacons, travelers can now discover a host of experiences while they travel from easier airport navigation to discovering a new city through access to rich digital content on their mobile phones to personalized hotel experiences. Beacons are also of great value to players in the tourism and hospitality industry; beacons with their ability to source customer data around physical locations, activities, time and personal interests, provide a huge window of opportunity to target customers with personalized and contextual experiences in order to ensure business success. For example, given the data collected, restaurants and hotels can use beacons to regain any lost revenue by filling unbooked appointments simply by alerting nearby travelers of deals and offers.

This research is concentrated on the iBeacon technology which is still rather new to the industry and there is consequently not much existing research yet about the connection between these products and the degree to which they actually cause the adoption rate. Given this background, this paper uses a systems dynamics approach to build a conceptual model in order to illustrate the adoption of iBeacon in smart tourism destinations.

Thus, the purpose of this study is: (1) to examine the importance of factors affecting iBeacon adoption using system thinking approach; (2) to provide feedback structure of key factors in iBeacon adoption. Therefore, To analyze the adoption of smart technology (iBeacons) in smart tourism destination, this study examine the interrelationships and feedback structures of key factors in iBeacon adoption. To serve the purpose, we use case study of the SAIL Amsterdam and system dynamics approach to build a conceptual model in order to illustrate the adoption of iBeacon in tourism destination. The dynamic model has two goals in the context of the modelling literature: first, it illustrates the complex interactions between smart tourism and technology which can be modelled in detail and second, it illustrates the social systems which have often proved difficult to quantify.

2. Literature Review

2.1 iBeacon and its Applications in Tourism

iBeacon technology has witnessed adoption across diverse domains, from retail to education to museums, over the past few years. Although the retail industry has been the front runner in deploying beacon projects, the tourism industry has also seen significant transformation by leveraging beacons. Beacon technology was selected as the means, from which the application would develop, to ease the exploration of a city. Given the potential that beacon technology holds for show casing a wide offer of visiting alternatives [3]. Beacons, also referred to as iBeacons, were first introduced by Apple in 2013 (CISCO, 2014).

This new technology allows companies to receive important information from (potential) customers and send out valuable notifications to them based upon their exact location. The only prerequisites for this communication channel to work are that the customer has the company's iBeacon enabled app installed on his/her smartphone and that the customer has Bluetooth turned on. In other words, iBeacon is "Apple's technology standard, which allows Mobile Apps to listen for signals from beacons in the physical world and react accordingly" [4]. Therefore, iBeacons enable apps to grasp the users' position and deliver so-called hyper-contextual content to the users based on this information. This communication is enabled through Bluetooth Low Energy (BLE) which is a communication technology used for transmitting data over short distances. As the energy consumption is very low and the cost is considerably lower than traditional Bluetooth [4], this technology has the ideal prerequisites for the use idea behind iBeacons. Standard beacons allow a broadcasting range of up to 100 meters [4]. With an iBeacon network, brands, retailers, apps or platforms are able to enhance their knowledge of where their customers are located which provides them with an opportunity to send out "highly contextual, hyper-local, meaningful messages and advertisements" [4]. The technology therefore has the power to change the way brands communicate with their customers. As [4] puts, "iBeacon provides a digital extension into the physical world". Beacons require three main things in order to work, namely a hardware to "broadcast the Bluetooth signal" and a software to "receive and interpret the signal" [5]. This software enables companies to send messages or promotional offers to users at any time.

Finally, an app is needed to actually reach the customers as the hardware and the software only work in the background, meaning they aren't visible to customers. The tracking of customers would also be possible by using GPS (Global Positioning System), but this function requires an internet connection. Consequently, battery power is used and the connection might be disrupted, or not be available at all, due to the big amount of people attending such an event. Thus, a huge advantage of beacons is that they don't need internet in order to work which saves battery power and increases the availability and usability of the app. In addition to that, phones will automatically recognize beacons and push-notifications are sent by the beacons to the users, if the app is installed and Bluetooth is activated. However, beacons are still a comparably new technology and due to this many consumers are also not yet familiar with the functions and requirements e.g. in terms of the battery power.

2.2 Smart Tourism Destination

Smart tourism destination can be defined as the following: "a platform, which is implementing ICTs such as Artificial Intelligence, Cloud Computing and Internet of Things to offer the tourist personalized information and enhanced services established by mobile end-user devices" [6]. In order to make a tourism destination smart the dynamic connection of stakeholders through technological platforms is a key factor. The main objective of these platforms is to create a quick information exchange regarding all tourism related activities [7].

[2] asserted that ICT infrastructure in smart destinations has been developed in two fold, a) Allocating modern mobile technology in the intelligent mobile surroundings, b) Fortifying the cooperation between technology enterprises and tourism stakeholders to foster the foundation of the innovation ecosystem. Dynamicity of Smart Businesses in the smart tourism ecosystems could enhance tourism stakeholders to manage the resources in the automated methods [1]. In Smart Tourism Destination, the portion of real-time information trend produces a notable amount of data

sets that is called Big Data [7]. It is essential for ICT infrastructure in smart tourism destinations to be concentrated on both technological and touristic aspect simultaneously. [8] identify three main components of the ICT necessary to enhance smartness in a tourism destination: "Cloud Computing, Internet of Things (IoT) and End-User Internet Service System". Cloud Computing helps reducing fixed costs and sharing information. The Internet of Things the means that not just screens are connected via the Internet, but also other items and that they all illustrate one big network. The IoT generally supports "providing information and analysis as well as automation and control" while the End-User Internet Service System refers to different applications at different levels [8]. The key aspect of smart destinations is the integration of ICTs into physical infrastructure. Barcelona, for instance offers travelers interactive bus shelters that not only provide touristic information and bus arrival times but also USB ports for charging mobile devices. In addition, it makes bicycles available throughout the city and travelers can check their locations via a smartphone app, thereby fostering environmentally friendly transportation around city (http://smartcity.bcn.cat/en/bicing.html). The city of Brisbane has recently mounted over 100 beacons onto points of interest to communicate information to tourists via a mobile app if they are within a certain radius of the location https://link.springer.com/article/10.1007/s12525-015-0196-8). Amsterdam uses beacons to let tourist signs translate themselves into different languages and the Amsterdam Arena is testing sensors for better crowd management (http://amsterdamsmartcity.com/).

2.3 ICT Adoption in Tourism

Technology acceptance behaviour has been deployed in previous research in tourism [9]. The initial TAM suggests that 'perceived ease of use' which demonstrate the level of user friendliness in specific technology in addition to 'perceived usefulness' as the user's perception of specific

<Table 1> Operational Definition of the Main Variables

Main Variables	Operational Definition	References
Perceived Usefulness	It is "the degree to which a person believes that using a particular system would enhance his/her job performance"	[10]
Privacy Concern	The privacy concern was initially defined as the individual's ability to control the conditions under which his/her personal information is collected and used	[14]
Perceived Risk	Perceived risk (PR) is commonly thought of as felt uncertainty regarding possible negative consequences of using a product or service. It has formally been defined as "a combination of uncertainty plus seriousness of outcome involved"	[15]
Social Influence	Social influence is the extent to which members of a social group influence one another's behavior in adoption	[16]
Perceived Ease of Use	Davis defined this as "the degree to which a person believes that using a particular system would be free from effort"	[10]
Subjective Norm	"A person's perception that most people who are important to him think he should or should not perform the behavior in question"	[17]
Attitude	Ajzen described attitude as a pre-disposition to respond favorably or unfavorably to an object, person, event, institution, or another discriminable aspect of the individual's world.	[18]

functionality in such technology are the predictors of end-users' attitude towards technology which finally lead to adoption or rejection of technological innovation [10]. For instance, [11] argues that availability of a device is one of the materials for performing the behaviour.

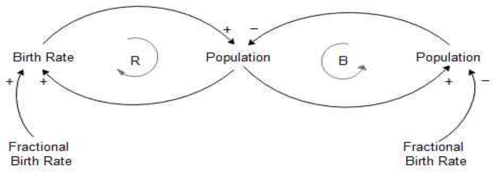
Furthermore, in the study on iBeacon, [12] argue that competitiveness of iBeacon refers to the potential of these devices to retain in the industry competitions. Although accessibility and affordability do not guarantee for the user's intention to accept a new technology [1], development of the relevant information via application (apps) in the particular context [12] could fortify the user's perception of the functionality for technological innovation. [13] found that drawing up on various technology acceptance and media theories, the authors develop a model to understand how people react to Augmented Reality Smart Glasses (ARSGs) using the example of Microsoft HoloLens. Results show that consumer's adoption decision is driven by various expected benefits including usefulness, ease of use, and image. However, hedonic benefits were not found to influence the adoption intention.

3. Methodology

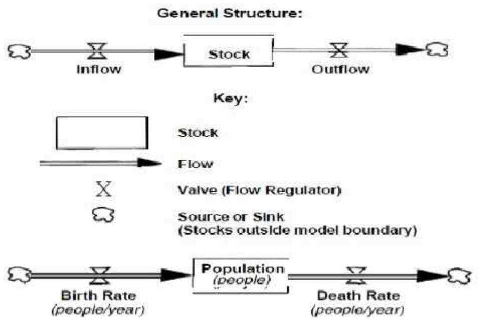
3.1 System Dynamics

System dynamics is a methodology developed by Forrester to understand the structure and dynamics of complex systems [19]. It is a computer-aided approach for analysing and solving complex problems with a focus on policy analysis and design. System dynamics mainly to understand the dynamic behaviour of complex physical, biological, and social systems using a perspective of information feedback and delays, which is the essential viewpoint to cause the behaviour of systems in system dynamics. System dynamics simulation is a methodology that examines how feedback loops, accumulations, and time delays between various factors influence the behavior of a complex system over time. Researchers have started to conceptualize platforms as dynamic systems and examine how they develop through time. For instance, [20]. Uses a systems dynamics (SD) approach to build a conceptual model in order to illustrate the adoption of smart glasses in smart tourism destinations. [21] also uses causal loop diagram to explain a conflict, the change of a system, or merely the interactions that take place to obtain an effect. In this study, based on previous literature review and technology acceptance model regarding new technology adoption in smart tourism causal loop diagram was formulated.

The study mainly adopted system dynamics Causal loop diagrams (CLD) for adoption of iBeacon in smart tourism destination. [22] CLDs are a qualitative diagramming language for representing the feedback structure of systems. A CLDs consists of variables connected by arrows denoting causal influences among the variables. The important feedback loops are also identified in the diagram. In CLDs, variables are related by causal links, shown by arrows. Each causal link is assigned a polarity, positive (+) or negative (-) to indicate how the dependent variable changes when the independent variable changes. The important loops are emphasized by a loop identifier which shows whether the loop is a positive (reinforcing) or negative (balancing) feedback.



[Fig. 1] Causal Loop Diagram Example



[Fig. 2] Stock and Flow Diagram Example

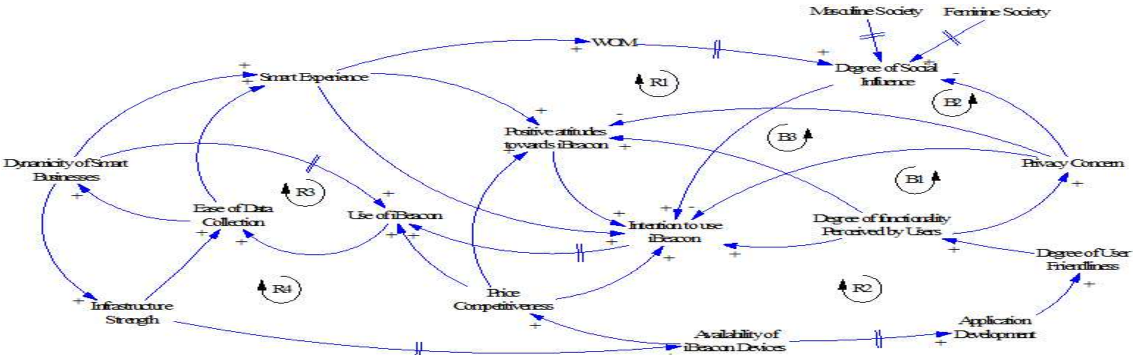
[Fig. 1] showed an example of CLDs, and in the example, the birth rate is influenced by population and the fractional birth rate. System Dynamics uses particular diagramming notation for stocks and flows [Fig. 2]. Stocks are represented by rectangles (suggesting a container holding the contents of the stocks). Inflows are represented by pipe (arrow) pointing into (adding to)the stock. Outflows are represented by pipes pointing out of (subtracting from) the stock. Valves control flows. Clouds represent the sources and sinks for the flow. In our study, the system dynamics model encompasses key feedback loops related to the adoption of iBeacon in smart tourism destination.

4. Case Study and Dynamic Hypothesis

4.1 Real World Case: iBeacon Implementation in SAIL Amsterdam 2015[5]

In the year of 2014, the Netherlands were visited by 13.9 million international tourists (NBTC, 2015). This represents an increase of over 40% in comparison with tourist numbers in the year of 2000. This number is fairly impressive considering that the Netherlands only has an area of just over 41,000 km2 and is home to 16.5 million people (Holland.com, n.d.). SAIL is the largest world-wide nautical event and takes place every five years in the harbors of the city of Amsterdam. During the event, which lastly took place on five consecutive days in August 2015, around 600 ships navigate their way along the North Sea Canal towards the IJhaven in Amsterdam. Ships include not only modern ships but also tall ships and historic Dutch vessels. Apart from this spectacle, there are many cultural events and sporting activities taking place in the surroundings. With over 2.3 million visitors in the SAIL Amsterdam 2015 edition, the event represents the largest public event in the Netherlands (I Amsterdam, n.d.). Of the 2.3 million total tourists visiting the SAIL Amsterdam event in 2015, 69% came to see the event on one of the five days. 16% represented two-day visitors and 14% visited the event on three or more days.

In the 2015 SAIL Amsterdam edition, the new beacon technology was implemented for the first time on such a scale. With over 2.5 million expected

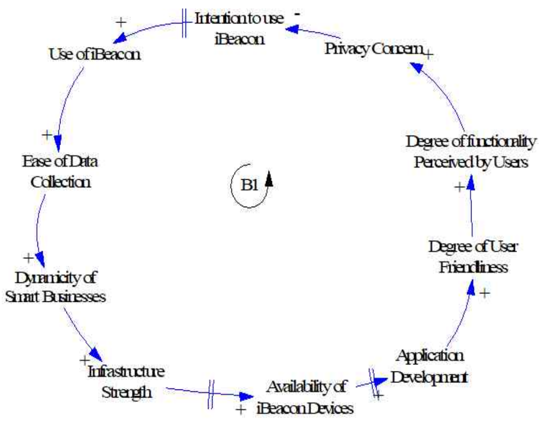


[Fig. 3] The proposed CLD for adoption of iBeacon in smart tourism destination visitors, this event was the biggest iBeacon showcase that has ever taken place world-wide (iBeacon, n.d.). During SAIL, visitors were provided with different iBeacon interactions which were based upon the individual visitor's location and his/her behavior during the previous days of the event. Notifications included ship information but also information about upcoming events, news and promotions which were available at the point in time (I Amsterdam, n.d.). For the sake of the beacon implementation, 232 beacons were installed which created a total of five private and public beacon networks. These included the Amsterdam Beacon Mile, SOWIFI, Exterion Media, the SAIL long range ship network and the SAIL event network. With these five networks, the whole SAIL area as well as the city center of Amsterdam was covered (I Amsterdam, n.d.). Six different types of beacons were employed and 10 tall ships were equipped with long-range beacons which allow a transmission of up to 300 meters. This enabled visitors to receive a notification on their phone whenever one of these interesting ships was close-by (when using the app). The organizers in SAIL Amsterdam have used this technology and the related app for the first time in 2015 and business contacts helped to find out about practical experiences.

4.2. System Thinking Model

By using casual loops diagrams as a tool and considering the above mentioned factors we tried to focus on understanding the cause and effect relationships of each indicator. The presented casual loops diagram (figure 1) is mainly divided into three main sub-systems: subjective norms, iBeacon' technological factors and smart tourism destinations. The presented casual loops diagram (figure 3) is mainly divided into three main sub-systems: subjective norms, iBeacon' technological factors and smart tourism destinations. As shown in the diagram, the masculine and feminine societies have delayed impacts on social influences. We presented the main feedback loops of the model based on literature review and case study that are illustrated in [Fig. 3] and are explained as below in the hypotheses as well:

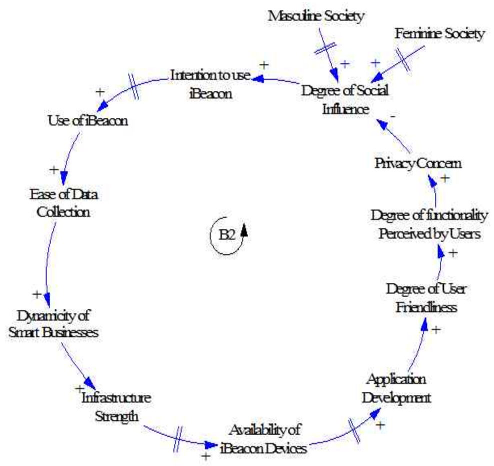
4.3 Hypothesis 1 (Balancing Feedback Loop B1)



[Fig. 4] Balancing Feedback Loop (B1)

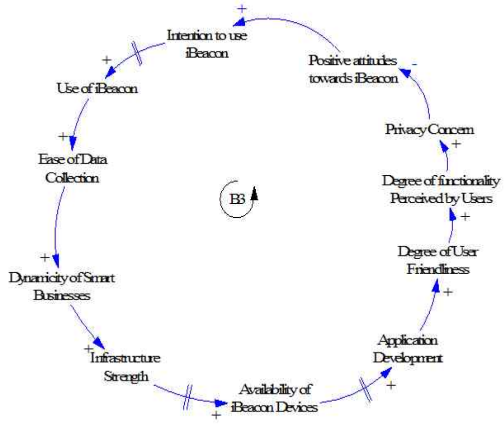
Dynamic Hypothesis 1: Increase in usefulness perceived by the users regarding the functionality of iBeacon that will contribute to increasing the concerns about the people's privacy will have a negative impact on the intention to use iBeacon [Fig 4. Loop B1]. According to [23] privacy risk harm negatively impact their intentions to use technology. The threat to individual's privacy will raises concern in particular technology. [23] state that privacy risk factors are found to negatively influence consumer intentions. Although accessibility and affordability do not guarantee for the user's intention to accept a new technology [1], development of the relevant information via application (apps) in the particular context [12] could fortify the user's perception of the functionality for technological innovation.

4.4 Hypothesis 2 (Balancing Feedback Loop B2)



[Fig. 5] Balancing Feedback Loop (B2)

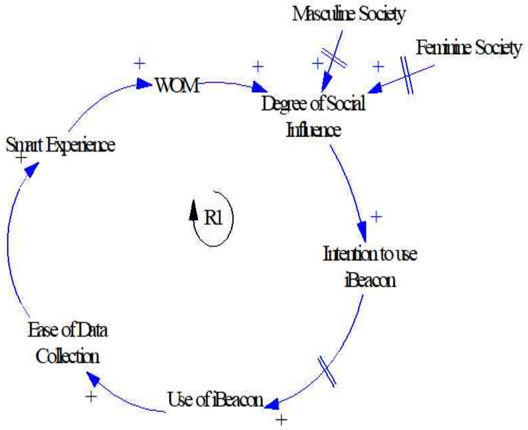
Dynamic Hypothesis 2: Decrease in privacy concern has significant influence on Degree of social influence. As indicated in CLD, (Fig 5. loop B2) is the result of changes in technology related factors such as increase in awareness regarding the functionality of iBeacon that will contribute to increasing the concerns about the people's privacy. As shown in the diagram, the masculine and feminine societies have delayed impacts on social influences. [12] assert that social influences play significant roles in the circumstances in which individuals employ an innovation visibly in front of the others. For instance, using ICT advancement vary according to the cultural value for masculine societies with the main focus on self-confident, and value for work in person' life compare to feminine societies that are mainly considered modesty and spending more time on leisure activities [24]. The other source of the influential attribute in hospitality and tourism industry is word-of mouth (WOM) [25].



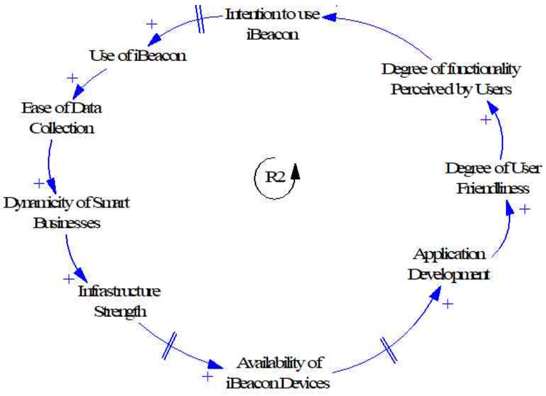
[Fig. 6] Balancing Feedback Loop (B3)

4.5 Hypothesis 3 (Balancing Feedback Loop B3)

Dynamic Hypothesis 3: Decrease in perceived risk has significant influence on positive attitudes towards, iBeacon. Based on [26,27] research, perceived risk has negative and significant influence on attitude towards technology. It means that if perceived risk increase, consumer attitude will decrease and vice versa. It is different from offline consumer, online consumer has connection with risk in online activities like the technology accepted is not appropriate with it is known to be, the product is not delivered after payment, the product quality is different from what it has promised. Therefore if perceived risk on technology is high so attitude on technology will be negative or can be said that relation between perceived risk and attitude on technology is negative. Therefore, decrease in privacy concern will increase positive attitudes on iBeacon [Fig 6. loop B3].



[Fig. 7] Reinforcing Feedback Loop (R1)



[Fig. 8] Reinforcing Feedback Loop (R2)

4.6 Hypothesis 4 (Reinforcing Feedback Loop R1)

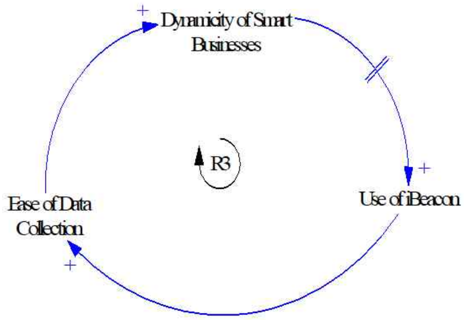
Dynamic Hypothesis 4: Degree of Social Influence will have has significant influence on Intention to use iBeacon (Fig 7. loop R1). Agreeableness has a significantly positive and direct effect on Subjective Norms. Social influence has been shown to play an important

role in the technology acceptance process [28,29]. Image is another social influence concept which refers to the extent to which an innovation is perceived as enhancing one's status in a social system [30,31]. Both Subjective Norms and image are important determinants of behavioral intention because they reflect the influence of others and the importance of having others to think positively of us [32]. [32] found support for Agreeableness moderating the relationship between Subjective Norms and intentions to use the technology such that the relationship is stronger for individuals with higher Agreeableness. The technology mediated experience of using iBeacon in a destination motivates users to use word of mouth to spread what they have experienced.

4.7 Hypothesis 5 (Reinforcing Feedback Loop R2)

Dynamic Hypothesis 5: User friendliness of

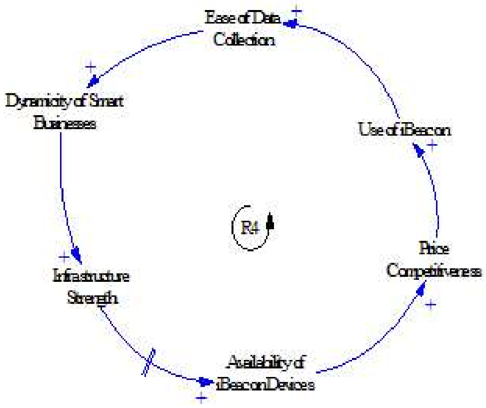
the iBeacon affect the level of functionality perceived by users (Fig 8. loop R2). TAM proposes perceived usefulness (PU) [10] and perceived ease of use (PEOU) determine intention to accept a technology. Empirical evidence has shown that PEOU does have an effect on intention to accept not only directly but also indirectly through PU [10]. In a smart destination, a strong infrastructure facilitate the big data process which contributes to the dynamics of smart businesses and can provide a better experience for users. In this light we anticipate the same to be true in the case of acceptance of the biometric technology. Attitude toward using sequentially has influence on behavior intention to use, which is the key factor for determining actual conditions of system use, while belief of perceived usefulness also affects behavioral intention to use over attitude toward using [33].



[Fig. 9] Reinforcing Feedback Loop (R3)

4.8 Hypothesis 6 (Reinforcing Feedback Loop R3)

Dynamic Hypothesis 6: Increasing the dynamicity of smart businesses gradually increase the use of iBeacon [Fig 9. loop R3]. Dynamicity of Smart Businesses in the smart tourism ecosystems could enhance tourism stakeholders to manage the resources in the automated methods [1]. In Smart Tourism Destination, the portion of real-time information trend produces a notable amount of data sets that is called Big Data [8]. It is essential for ICT infrastructure in smart tourism destinations to be concentrated on both technological and touristic aspect simultaneously. Importantly, smart tourism spans three layers across these three components: a smart information layer that aims at collecting data; a smart exchange layer that supports interconnectivity; and, a smart processing layer that is responsible for the analysis, visualization, integration and intelligent use of data.



[Fig. 10] Reinforcing Feedback Loop (R4)

4.9 Hypothesis 7 (Reinforcing Feedback Loop R4)

Dynamic Hypothesis 7: Availability of iBeacon creates a competitive market that increase the use of iBeacon within a smart destination [Fig 10. loop R4]. The influence of Innovativeness has been shown to be a significant direct predictor of behavioral intention to use new technologies. However, it has also been suggested that individual innovativeness might be a predictor of the TAM and DOI variables [34-36] confirm that, regardless of the measure or the innovation acceptance settings, the disposition towards innovativeness directly determines three characteristics, namely perceived usefulness, ease of use and compatibility. 〈Table 1〉 gave the operational definitions of the main variables and references.

4.10 Adoption Analysis with Causal Loop Diagram

By using casual loops diagrams as a tool and considering the above mentioned factors we tried to focus on understanding the cause and effect relationships of each indicator. The presented casual loops diagram [Fig. 2] is mainly divided into three main sub-systems: subjective norms, iBeacon' technological factors and smart tourism destinations.

As shown in the diagram, the masculine and feminine societies have delayed impacts on social influences. As indicated in CLD, loop B2 is the result of changes in technology related factors such as increase in awareness regarding the functionality of iBeacon that will contribute to increasing the concerns about the people's privacy. The technology mediated experience of using iBeacon in a destination motivates users to use word of mouth to spread what they have experienced (loop R1). In a smart destination, a strong infrastructure facilitate the big data process which contributes to the dynamics of smart businesses and can provide a better experience for users.

The delays in lead time of beacon Device manufacturer and developing the related and suitable applications will cause a thread of delays in our model. As mentioned, User friendliness of the iBeacon affect the level of functionality perceived by users (loop R2). Meanwhile, availability of iBeacon creates a competitive market that affect the use of iBeacon within a smart destination (loop R4). Simultaneously, by increasing the dynamicity of smart businesses gradually the use of iBeacon increases (loop R3).

5. Conclusion

Through the study, 7 variables related to the iBeacon adoption in smart tourism destination were examined through a dynamic analysis. By connecting all the variables, the diagram for the cause and effect was systematically constructed. The result of this study had several contributions. First the preliminary research on the influential parameters of tourists' intention to accept iBeacon in SAIL Amsderdam 2015 denoted that social factors were the significant predictors for the behavioral intention to accept iBeacon. In addition, the moderating role of culture such as masculinity/ femininity indicated a substantial influence on the tourists' behavioral intention. From the previous literature and case study, we built our proposed framework which can be used as a foundation for further discussion in order to create a holistic approach for smart tourism destinations. The interaction with the visitors of SAIL Amsterdam and literature review helped us to identify key players of the system and define essential feedbacks structure of the systems' components and explore interrelations of the intention to use iBeacon. In this context, this paper proposes causal loop diagram which describes how systems are interconnected and focus on critical feedback structure.

In this study, we use system thinking and causal loop diagram to examine the adoption mechanism of iBeacon in smart tourism destination. CLD is not a one way causality study like linear studies (empirical studies). It examines complex non-linear feedback structural model. Therefore, it is very important to study the dynamic viewpoints of technology adoption study in smart tourism destination. We have explained the feedback effect of iBeacon adoption in smart tourism destination in dynamic hypothesis.

However, due to the sort of limitation which is also the essence of all research, the limitation of this study is absence of stock and flow simulation analysis, Therefore, in our future study we will upgrade the current CLD model into stock and flow simulation analysis. The, next steps in our future study will be the implementation of the model through stock and flow simulation analysis. The future study is needed to check the sensitivity through the simulation tools. Parameters of system dynamics models are subject to uncertainty, so sensitivity analysis is an important task for the reliability of simulation results.

REFERENCES

[1] Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: foundations and developments. *Electronic Markets*, 25(3), 179-188.

[2] Lamsfus, C., Martín, D., Alzua-Sorzabal, A., & Torres-Manzanera, E. (2015). Smart tourism destinations: An extended conception of smart cities focusing on human mobility. *In Information and communication technologies in tourism* 363-375. Springer, Cham.

[3] Ho, T. Y., Chen, C. H., Chien, S. F., Chen, Y. H., Liu, S. Y., & Bayona, J. S. (2015, August). BeaconPass: A Location Based APP Game for Traveler. *In International Conference on Universal Access in Human-Computer Interaction,* pp. 288-297. Springer, Cham.

[4] iBeacon Insider (1995). What is iBeacon? A guide to Beacons. Retrieved December 14th, 2015 from: http://www.ibeacon.com/what-is-ibeacon-a-guide-to-beacons/

[5] Barten, C. (2016). Smart Technologies in Tourism. *Smart Technologies in Tourism Student Conference*, April, 2016.

[6] Boes, K., Buhalis, D., & Inversini, A. (2015). Conceptualising smart tourism destination dimensions. *In Information and communication technologies in tourism,* 391-403.

[7] Buhalis, D., & Amaranggana, A. (2015). Smart tourism destinations enhancing tourism experience through personalisation of services. I*n Information and communication technologies in tourism,* 377-389.

[8] Buhalis, D., & Amaranggana, A. (2013). Smart tourism destinations. *In Information and communication technologies in tourism,* 553-564.

[9] Tom Dieck, M. C., Jung, T., & Han, D. I. (2016). Mapping requirements for the wearable smart glasses augmented reality museum application. *Journal of Hospitality and Tourism Technology,* 7(3), 230-253.

[10] Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science*, 35(8), 982-1003.

[11] Mathieson, K. (1991). Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior. *Information systems research*, 2(3), 173-191.

[12] Hein, D. W., & Rauschnabel, P. A. (2016). Augmented reality smart glasses and knowledge management: A conceptual framework for enterprise social networks. *In Enterprise social networks* (pp. 83-109). Springer Gabler, Wiesbaden.

[13] Kalantari, M., & Rauschnabel, P. (2018). Exploring the Early Adopters of Augmented Reality Smart Glasses: The Case of Microsoft HoloLens. *In Augmented Reality and Virtual Reality,*. 229-245. Springer, Cham.

[14] Westin, A. F. (1967). Privacy and freedom, atheneum. New York, 7.

[15] Bauer, R. A., & Cox, D. F. (1967). Risk taking and information handling in consumer behavior. Boston: Harvard University, 469-486.

[16] Konana, P., & Balasubramanian, S. (2005). The social–economic–psychological model of technology adoption and usage: an application to

online investing. *Decision Support Systems*, 39(3), 505-524.
[17] Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research. Addison-Wesley
[18] Ajzen, I., & Fishbein, M. (1988). Theory of reasoned action-Theory of planned behavior. University of South Florida.
[19] Forrester, J. W. (1961). Industrial Dynamics. Portland. Productivity Press.
[20] Sedarati, P., & Baktash, A. (2017). Adoption of Smart Glasses in Smart Tourism Destination: A System Thinking Approach. *Tourism Travel and Research Association: Advancing tourism Research Globally, 13. 2017 ttra international conference*, Quebec, Canada.
[21] Delgado-Maciel, J., Cortés-Robles, G., Alor-Hernández, G., Alcaráz, J. G., & Negny, S. (2018). A comparison between the Functional Analysis and the Causal-Loop Diagram to model inventive problems. *Procedia CIRP*, 70, 259-264.
[22] Sterman, J. D. (2000). Business dynamics: systems thinking and modeling for a complex world (No. HD30. 2 S7835 2000).
[23] Cazier, J. A., Jensen, A. S., & Dave, D. S. (2008). The impact of consumer perceptions of information privacy and security risks on the adoption of residual RFID technologies. *Communications of the Association for Information Systems*, 23(1), 14.
[24] Hofstede, G., & Minkov, M. (2010). Long-versus short-term orientation: new perspectives. *Asia Pacific business review*, 16(4), 493-504.
[25] Litvin, S. W., Goldsmith, R. E., & Pan, B. (2008). Electronic word-of-mouth in hospitality and tourism management. *Tourism management*, 29(3), 458-468.
[26] Van der Heijden, H., Verhagen, T., & Creemers, M. (2003). Understanding online purchase intentions: contributions from technology and trust perspectives. *European journal of information systems,* 12(1), 41-48.
[27] Ma'ruf, J. J., Mohamad, O., & Ramayah, T. (2005). Intention to purchase via the internet: a comparison of two theoretical models. *Asian Academy of Management Journal*, 10(1), 79-95.
[28] Malhotra, Y., & Galletta, D. (2005). A multidimensional commitment model of volitional systems adoption and usage behavior. *Journal of Management Information Systems*, 22(1), 117-151.
[29] Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS quarterly*, 115-139.
[30] Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation, Information systems research, 2(3), 192-222.
[31] Venkatesh, Viswanath, and Fred D. Davis.(2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science* 46(2), 186-204.
[32] Devaraj, S., Easley, R. F., & Crant, J. M. (2008). Research note—how does personality matter? Relating the five-factor model to technology acceptance and use. *Information systems research*, 19(1), 93-105.
[33] Taylor, S., & Todd, P. (1995). Assessing IT usage: The role of prior experience. *MIS quarterly*, 561-570.

[34] Mun, Y. Y., Jackson, J. D., Park, J. S., & Probst, J. C. (2006). Understanding information technology acceptance by individual professionals: Toward an integrative view. *Information & Management*, 43(3), 350-363.

[35] H.L. Mu & Y.C.Lee. (2018). Analyzing the Adoption of Online Payment using System Dynamics.*Journal of Industrial Convergence,* 16(1), 1-14.
DOI : 10.22678/JIC.2018.16.1.001

[36] Y. C. Lee, D. H. Seo & S. H. Song. (2017). Classification and Evaluation of Service Quality Factors of O2O Delivery Applications Using Kano Model. *Journal of Industrial Convergence,* 15(2), 27-36.
DOI : 10.22678/JIC.2017.15.2.027

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