Designing for an AI-enabled smart service adoption from a user experience perspective

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'Industry 4.0', 'Digitalization', 'Internet of Things (IoT)' and 'Smart Services' have become today's buzzwords due to the advanced development of information and communication technologies (ICTs). Consequently, the world economy has changed from a physical product dominated economy to a more software and service-controlled economy. It is no longer about the product that matters, but it is about the data that is generated by using the product or service. The data arising from the use of products can be used to define new business models and services to foster long-term sustainable competitive advantage. How to create smart services by collecting and using these data is not only an opportunity, but also a challenge for companies to remain competitive in highly dynamic market contexts. Smart services can be defined as services tailored to specific user needs with the help of data and intelligent processing. It requires a deep understanding of users and their particular contexts of use and an intelligent processing of these emergent data. User adoption of smart services should be properly understood, on the one hand; on the other hand, this understanding could be processed to enable smart interventions that support the users and how they interact with this technology on a regular basis.

The understanding of user adoption within smart service research still requires considerable attention. A platform to collect, integrate and process user information and their usage data continuously is, therefore, essential to the development of smart services. In this study, an AI-enabled framework called 'Smart Service Blueprint Scape' (SSBS) is proposed to increase the knowledge associated with the user experiences of smart services. The framework demonstrates the elements of smart services by providing an integrated approach from the perspectives of both user experiences and AI system.

With the purpose of improving the smart service adoption, three smart mobility service cases were critically analyzed, through making use of the framework to demonstrate how the users' experiences were enabled by the SSBS framework. YouTube movie clips of these three smart mobility services were analyzed to collect the data for illustrating how the SSBS was utilized. Through the qualitative analysis, the values of an SSBS framework were identified through three aspects. Firstly, the interactive relationship with users and service provision of the smart services process is demonstrated. Secondly, the integration of user experience and AI system is further elaborated. Finally, the dimensions reflecting characteristics of smart services are identified: the connection among smart devices, AI and support process. Designers can maintain and communicate with different stakeholders within the smart service delivery process. The framework creates the systematic overview for smart service with the help of AI system.

***Keywords**: Smart service; adoption; user experience; artificial intelligence; SSBS framework*

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Introduction

'Smart' is a widely used attribute nowadays. Earlier researchers mentioned that 'Smart' was used as the description for the development of technology, economy and society (Liu et al., 2019). The technologies that rely upon the sensors, big data, open data and novel approach of information connectivity drive the development of 'Smart' (Gretzel, Sigala, Xiang & Koo, 2015). The academic and business world agree that technology has been a considerable propulsion behind the progress of today's service world (Meuter et al., 2005). The growing interests in smart services have been led by the interest in technology from a service perspective (Wünderlich et al., 2015). 'Smart services' can be defined from the context, which are realized by intelligent technology, in detecting and analyzing the data. Smart products play the role of the boundary products that can generate data and be embedded in smart systems (Beverunge et al., 2017). The IoT, big data, artificial intelligence (AI), storage, transmission and digitalization are beneficial in the data processing. Smart services are undergoing a tremendous development, which allows real-time data collection, continuous communication and interactive feedback. However, the related academic research is still in the initial stage (Wünderlich et al., 2015). It is important to involve the technological changes in the improvement of service strategy (Huang & Rust, 2017). The goal of technological progress is to develop novel and transforming services and change the way customers behave. Therefore, understanding how AI will alter service delivery is vital and far-reaching (Wünderlich et al., 2015).

Research by Russell (2002) illustrated that AI can be broadly defined as the intelligent system/machines which are capable of thinking and learning. They can mimic the cognitive functionalities of the human mind. The common elements of AI are language and image processing, machine learning and machine vision (Jarrahi, 2018). AI technologies are rapidly expanding in diverse context and they play an increasingly more important role in semi-autonomous decision making during its development (Davenport & Kirby, 2016). Human-interaction within intelligent context-aware computing systems is a topic that researches have studied for decades (Bellotti & Edwards, 2001). Nevertheless, there are growing concerns about the fact that AI intelligence embodied within the machines may eventually outthink and replace humans in the workplace (Guszcza et., al, 2017). The discussion on enabling human and AI to interact harmoniously and collaboratively is still lacking attention within the human-AI research area (Siegel & Kennedy, 2016).

It remains debatable whether AI-enabled services can completely replace the human decision-making process (Yang, Lee & Lee, 2018). Generally, humans are unwilling to leave all decision-making authority to machines. In addition, the level of AI that people require for 'smartness' would also vary according to their individual characteristics and circumstances. Some people feel scared about any intelligent things, although the fear is vague. For example, when AlphaGo defeated humans in the Go game, some people had a negative view of AI because they thought computers could control or be harmful to people. Therefore, the level of 'smartness' that people prefer may include smartness within a limited range under human control, which contradicts the theoretical point of view (Yang, Lee & Lee, 2018).

Hence, getting everyone to adopt AI is still a challenge (Alsheibani, Cheung & Messom, 2018). Although the advanced development of the smart service has brought huge benefits to industry and economy, contemporary academic research is still limited. Gaining in-depth understanding of the customers' adoption is one of the key elements which affect successful development (Norman, 2009). Acquiring customer acceptance and improving the usage of the smart services and adoption are the main challenges and obstacles that service developers face (Biehl, Prater & McIntyre, 2004). Consequently, how to design human-AI interactions, which on the one hand allow users to benefit from the advantages brought along by AI technologies, while on the other hand still leaving them in control of such AI technologies, is the dilemma this paper would like to address.

Diffusion and adoption research have a rich history and has been studied in a wide range of areas, Diffusion of Innovation (DOI) Theory, developed by E.M. Rogers in 1962 is one of the well-known social science theories (Dearing, 2009). It originated in communication to explain how an idea or technological product gains momentum and spreads through a social system. The results of this diffusion are that people in this social system, adopt a new idea, behavior, or product. Technological innovations have been investigated as an important factor in diffusion theory (Rogers, 1995). He also introduced diffusion models which are focusing on the individual adoption process and the social interaction behavior in the adoption of new technologies, in essence, technology adoption (Bajwa et al., 2008).

Technology adoption is the process which starts with user awareness of the technology and ends with the user embracing the technology and making full use of it. Technology acceptance is an attitude towards a technology, which can be affected by various factors. The former is led by the latter. In other words, full adoption will not occur if the user does not accept it (Rogers, 2010). In sociological studies, the domestication of technology is used to describe and analyze the process of technology’s acceptance, resistance and use (Haddon, 2003). It was developed following the ‘Shaping of technology’ perspective, where the user is perceived to lead the definition of technology in nature, scope and functions part (MacKenzie & Wajcman, 1999). The domestication adoption model was firstly proposed to describe the user acceptance and rejection. Users are treated as social entities and the model is used to raise a framework for better understanding of how the technology innovation changes and is changed, by their social context. Appropriation, objectification, incorporation and conversion are four dimensions in the domestication adoption process (Silverstone et al, 1992). Appropriation is the process of ownership of the artifact (Haddon, 2003); objectification is the process of the determination which roles the product will play (Siverstone et al., 1992); incorporation is the process of interacting with a product; conversion is the process of converting technology to intended feature use or interaction (Silverstone and Haddon,1996). According to Silverstone and Haddon’s (1996) research, the theoretical description of each dimension of domestication of technology can be observed in user experience research. Namely, the domestication of technology theory provides the theoretical basis for user experience (Hassenzahl & Tractinsky, 2006). Understanding the characteristics of the target users and their needs help adoption of the innovation (Scott, Plotnikoff, Karunamuni, Bize & Rodgers, 2008).

The user experience perspective can offer a connective approach to discover the relationship between AI and humans. In a sense, AI and user experience share the same aims, i.e. both are designed to interpret human behavior as well as predict what humans will do next (CJ Haughey, 2019). Smart services are not fully or only relying on the simple use of advanced technology, they also concern about the customers (Ellabban & Abu-Rub, 2016). The customer information is collected, integrated and analyzed by connected and harmonious technologies and eventually being used for enriching and personalizing the user experience (Gretzel et al., 2015). User experience is a series of strategies for understanding users' needs and behaviors and then applying that understanding to designing useful, usable systems and services (Pennington et al, 2016). It has been readily adopted by the human computer interaction (HCI) community (Forlizzi and Battarbee 2004). The entire affects that are elicited by a user and a product interaction include the aesthetic experience, the experience of meaning and the emotional experience. ‘User experience’ is associated with a wide variety of meaning, ranging from not just traditional usability but also to beauty, hedonism and the experiential aspects of technology use (Hassenzahl & Tractinsky, 2006). The consumers’ perceptions and usage of the service delivery technology has been explored in order to deal with the increasing focus of technology adoption in service (Meuter, Bitner, Ostrom & Brown, 2005). In a specific case study of the smart city service in London, the research group of Peng (2016) reported that the adoption and usage of smart technologies can reshape the structure, regulations and the way and the process of how-to deliver services to the users. The actual needs of the users are helpful and important for making decisions on the selection, implementation and deployment of smart services. Understanding the user groups and their specific characteristics, backgrounds and user interests are significant for conducting the smart services (Peng, Nunes & Zheng, 2016).

Multiple reasons affect the perception and adoption of smart services. In the smart interactive service context, the adoption behavior has been influenced by the user's personal characteristic, such as motivation, ability, trust in technology and self-consciousness (Zhu, Nakata, Sivakumar & Grewal, 2007). In the smart home context, the barriers of adopting smart services are coming from the control and apathy loss, reliability of technology, privacy and data security, cost of usage and trust (Balta-Ozkan, Davidson, Bicket & Whitmarsh, 2013). Wünderlich et al. (2015) identified that the perception and adoption of smart services are affected by the characteristics of technology and customer and context-specific perceptions. Privacy concerns included in the context-specific perceptions are the factors for smart service adoption. For instance, the invisibility of smart services featuring a high level of automated decision-making as well as the accessibility to all the sensitive information of customers to the service provider are perceived by customers as a high risk for adoption of smart services within the home. It was emphasized that the major barriers for smart service acceptance and adoption are concerns about security, need for personal contact, trust issues and control (Wünderlich et al., 2013). Among these, the fear caused by privacy violations and concerns on data security are now the main reasons that drive the increasing risk perception of customers (Keh and Pang, 2010).

The adoption of AI also carries with its significant concerns, particularly in automation on decision-making and control (Zerilli, Knott, Maclaurin & Gavaghan, 2019). When using AI-enabled machines, humans always expect to have control over them, however, these machines which are making autonomous decisions threaten this hierarchy. As a result, the autonomous machines may be seen as a threat to control and power over technology (Landau et al., 2015). Research showed that the lack of control options was seen as a main obstacle for adopting smart services by customers. In the same way as with AI adoption, they express a desire for the power to nullify or change the actions of a system as well as increasing visibility of these actions (Wünderlich et al., 2013). As a consequence, achieving flexible and dynamic condition of characteristics such as invisibility and control of autonomous decision-making of the smart service affect end consumers' smart service adoption is the main focus on improving the adoption of smart service (Wünderlich, et al., 2015).

Therefore, the aim of this paper is to propose a framework to provide personalized services from a user experience perspective along with data processing within the user context, focusing on the process of how users use and interact with the smart service. Through this framework, the authors aim at providing support to service designers to deal with the barriers of user adoption on smart services. This framework elaborates on the characteristics of the smart service and the interactive relationship between multi-stakeholders within smart services. For example, the interaction between the intelligent processing and the user actions during the use of the smart service. According to this research aim, this study consists of the following structure. It begins with the related work focusing on demonstrating what a smart service, service blueprint and servicescape are, which are the main tools of service design that will be used for having an essential understanding of the service delivery process in service design. Meanwhile, the dimensions of the initial SSBS framework will be introduced and illustrated in detail, the framework is derived from related work which will be elaborated. Thereafter, it is examined by analyzing three cases of smart mobility services. It is followed by the results of the three-case analysis, which create the base of the updated SSBS framework in the discussion section. The conclusion includes the study's contributions and limitations.

SSBS and Related works

Service blueprint and servicescape are tools that are used to help in understanding the delivery of services to customers in service design. Service blueprint mainly shows users' experience; Servicescape is the physical and social environment where the service encounters take place, which can affect users' service experience (Bitner, 1992). The smart elements of the servicescape were developed by Kang (2018) and her research group. It offers opportunities to create a framework for smart services design and highlighted the technology implementation side of smart service design.

Service blueprint

Service blueprinting was primarily raised by Shostack (1984) as a diagrammatic method to describe the working process of service provision in service design, which mainly shows the service delivery from the customers' point of view. It is clarified that service blueprinting consists of various components, such as customer actions, physical evidence, frontstage touchpoints, backstage actions and supporting services (Bitner, Ostrom, & Morgan, 2008). It demonstrates not only the service actions from customers' perspectives and experiences but also shows the backstage actions about how the service is delivered to users (Kazemzadeh, Milton & Johnson, 2015). In essence, service blueprinting encourages the service innovation to concentrate on not just the human-to-human but also human-to-technology interactions at the enterprise boundaries, instead of the software engineering level, allowing service designers to consider the perspective of the service backstage process without losing the connection to customer actions and process. Service blueprinting is a first-generation approach and is one of the primary service design tools for service designing (Bitner, Ostrom, & Morgan, 2008).

Servicescape

Bitner (1992) clarified that servicescape is the physical and social environment where the service encounters take place, which can affect users' service experience. When considering service experience, the phenomenological and social structural perspectives are needed as they can affect the whole service experience (Akaka, Vargo and Schau, 2015). Akaka et al. (2015) claimed that the service context, where service experiences are created, consists of the service encounters and the servicescape. When connecting smart services from the viewpoint of service experiences, they require the consideration of smart servicescape, involving the context and environment of smart services (Kang, Kwon, Kim, and Park, 2017). According to Kang (2018), the characteristics of smart servicescape are: Ambience, Space and Physical evidence.

Service blueprint can help the smart service designers to conceptualize the new design process enabling them to gain the understanding of the user experience during the smart service delivery process (Bitner & Crosby, 1989), while servicescape can help the service designers to connect user experiences with the smart service contexts. Since these two design methods discuss the user experience and intelligence of the smart service separately, this paper proposes an initial framework called 'Smart Service Blueprint Scape' (SSBS), as illustrated in Figure 1, to connect the user experiences into the smart service contexts and to the smart service delivery process. It aims to integrate the user experience and the smart characteristics for increasing the smart service adoption.

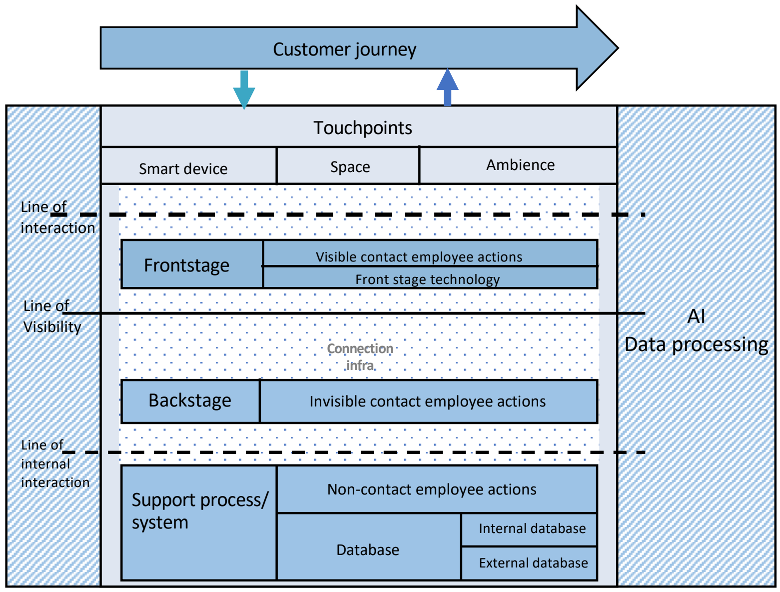

Figure 1 Initial Smart service blueprint scape (SSBS) framework

The following elements contain the components of the initial SSBS framework, the explanation of this framework arises from the service blueprint and servicescape literature.

Customer journey consists of all of the steps of the service that customers interact with, which are the central role of the creation of the blueprint. Customer actions are described in chronological order, they are usually listed first so that all other activities can be viewed as supporting the value proposition provided to or co-created with the customer (Bitner, Ostrom & Morgan, 2008).

Touchpoints are the entry which the service providers use to facilitate the service encounters and create interaction with customers (Surprenant and Solomon, 1987). Touchpoints are described as the moment of contact between customers and organizations (Zomerdijk & Voss, 2009). From Kang's research (2017), the touchpoint can be categorized as a smart device, space or ambience, which is parallel to the physical evidence. A smart device is divided into the categories of sensing, reasoning, and actuating. Space is positioned in the layout of all equipment, machinery and furnishings within the context. Ambience is positioned to consider about users' comfort level related to the ambient environment. The sound, light, air condition and scent aspects are included (Kang et al., 2018).

Frontstage is separated from the customer by the line of interaction. As part of face-to-face contact, these actions of front-line contact with employees are described as contact with employees on stage.

Backstage is another significant component of the blueprint, it mainly contains the invisible contact employee actions, the line of visibility that separates frontstage actions and backstage actions. The line of visibility is the dividing line between the company and customer. Below the line of visibility, the description of all other contact employee actions will be provided. The non-visible interaction with customers can consist of telephone calls as well as other activities that contact employees need to do so that they can serve customers (Bitner, Ostrom & Morgan, 2008).

The support process of the service blueprint is a critical component, separated by the line of internal interaction. In order to successfully deliver the service, the activities within the support process need to be carried out by the individuals and units within the company who are not contact employees (Lim & Kim, 2014).

Database stores the data which is generated after the intelligence is being implemented. It is basically a data pool that stores data in sequential and non-sequential formats. Network operators can access a large amount of data, which can be divided into internal data and external data (Choudhary & Patkar, 2016). Internal data is network-related data and subscribe-related data that is collected form the network, for instance: technical-fault, link availability, sensor data and so on. The external data is collected from third parties, for example, the demographic data, mapping data and public data (Kibria et al., 2018).

Artificial intelligence is defined as the reasoning part of data processing, which includes data sensing, collection, prediction and alarm notification. Artificial intelligence is a science that studies how to achieve intelligence, it performs like the mediating role in this framework (Russell and Norvig, 2002). In this research domain, the AI algorithms are employed to computerize the predictive analysis algorithms in order to filter, organize and search for patterns from the data collected from user actions and environmental data. It provides a probability analysis upon which service users can make effective and informed decision.

Connection infra exists to explain the infrastructure of network and cloud, the database and connection infra would be omnipresent in the service context (Kang et al., 2017).

Research Methodology and Tools

Mobility is a crucial element to improve life satisfaction and could be considered a prerequisite for healthy and active ageing as it relates to the basic human need for physical movement (Rantanen, 2013). Mobility has been defined as the ability for people to travel from destination A to destination B. Outdoor mobility can be explained as the physical ability to move, including walking by foot, or by other means of transportation (Mollenkopf et al., 2004). Smart services have been innovated and developed with the innovation of ICTs, like IoT and ubiquitous computing, new technology in traffic infrastructure makes car driving easier and more relaxed (Tacken, Marcellini, Mollenkopf, Ruoppila & Széman, 2005).

The service designers dedicate themselves to designing and organizing smart mobility services that provide suitable use of transportation for individuals to go out to do physical activities. Nevertheless, the infusion of smart technology into mobility services is still in progress and the ideal scope of smart mobility services has not yet been implemented in people's daily lives. Therefore, the service designers often create concept videos to demonstrate the intended user's use process and experience. Three future smart mobility concepts were selected, and their concept videos were used as the main source of data for the case study in this paper. Through analysis of these video clips by using the initial SSBS framework, the authors would like to learn what knowledge the service designers have used when designing their smart mobility services.

As can be seen in Table 1, it shows these three smart mobility services: Smart Mobility-Tampere, Finland (Business Tampere, 2017); Khon Kaen University (KKU) smart mass transportation (Khon Kaen University, 2015) and Mobility 2030 (KPMG, 2017).

Table 1 The list of referenced cases regarding smart mobility services.

Publisher channel	Data of publication	Tittle of video
Business Tampere	15.09.2017	Smart Mobility - Tampere, Finland
Khon Kaen University (KKU)	16.09.2015	KKU smart Mass Transportation
KPMG	20.04.2017	Mobility 2030

First, the authors watched the movie clips and gained the general consensus of whether it is a smart mobility service, they then developed the representative service scenario aiming to understand the general user journey of the travelers. Subsequently, the authors listed all the attributes, customer journeys, frontstage actions, backstage actions, AI and support process, of the paper according to the initial SSBS framework.

Second, the authors watched the videos again. The purpose of this repetition is to find out all the users' actions like customer actions which make up the customer journey map, the frontstage visible employee actions and the backstage invisible employee actions. At the same time, they matched these to each user action in the framework. Then, the user experience and smart mobility scenario was summarized.

Third, the technological attributes were written down, such as touchpoints and some AI and support system components, which were observed from the video. For some missing information that could not get from the video, the authors listed all the questions and sent emails to the cases' designers to get the first-hand information.

Finally, the initial SSBS framework was utilized to allocate the findings according to this framework. The authors iterated the relocation, combination, and addition of the features to make the framework more appropriate for the SSBS framework. Last but not least, the arrows were added to show the sequences and connections among each item during the allocation and organization of the SSBS framework. By using the smart mobility cases, some other non-obviously found AI was implied by figuring out the connection of each attribute. Consequently, the smart service blueprint scapes of the smart mobility service cases were established, as demonstrated in Figure 2, 3 and 4. After the analysis of the three cases with the original framework, the initial results were achieved. According, a User-AI decision loop representing the systematic view of AI-enabled smart services was concluded and represented in Figure 5. Based on all these findings, the SSBS framework was updated, as it exhibits in Figure 6.

Smart Mobility-Tampere, Finland

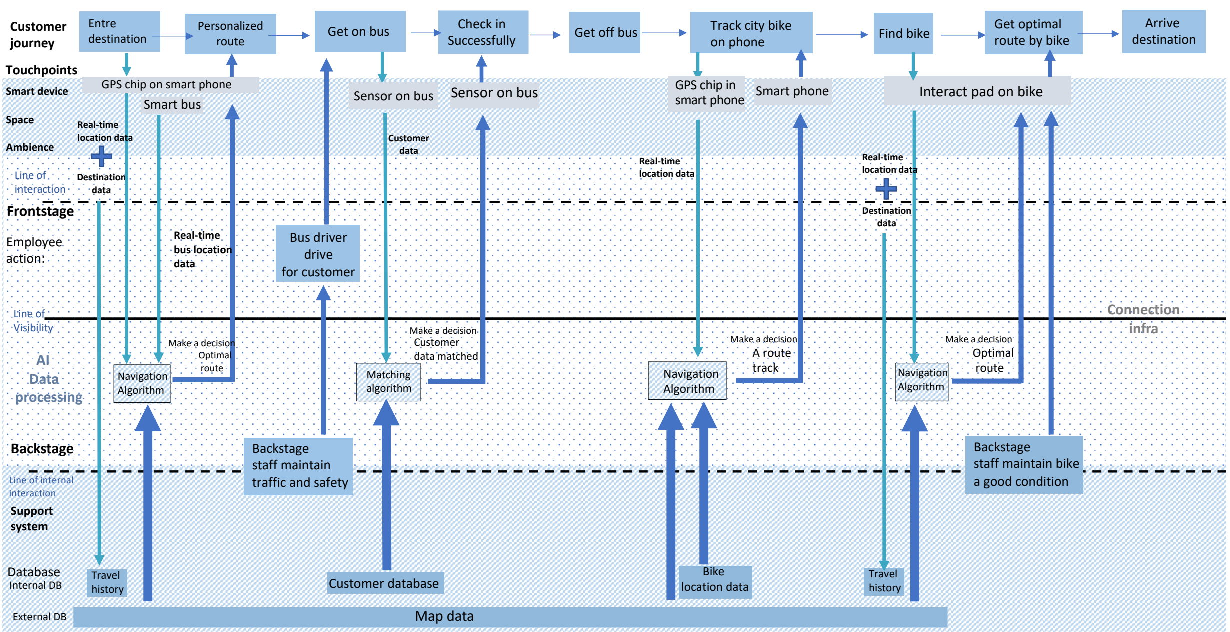

Figure 2 Smart mobility-Tampere, Finland

KKU Smart Mass Transportation

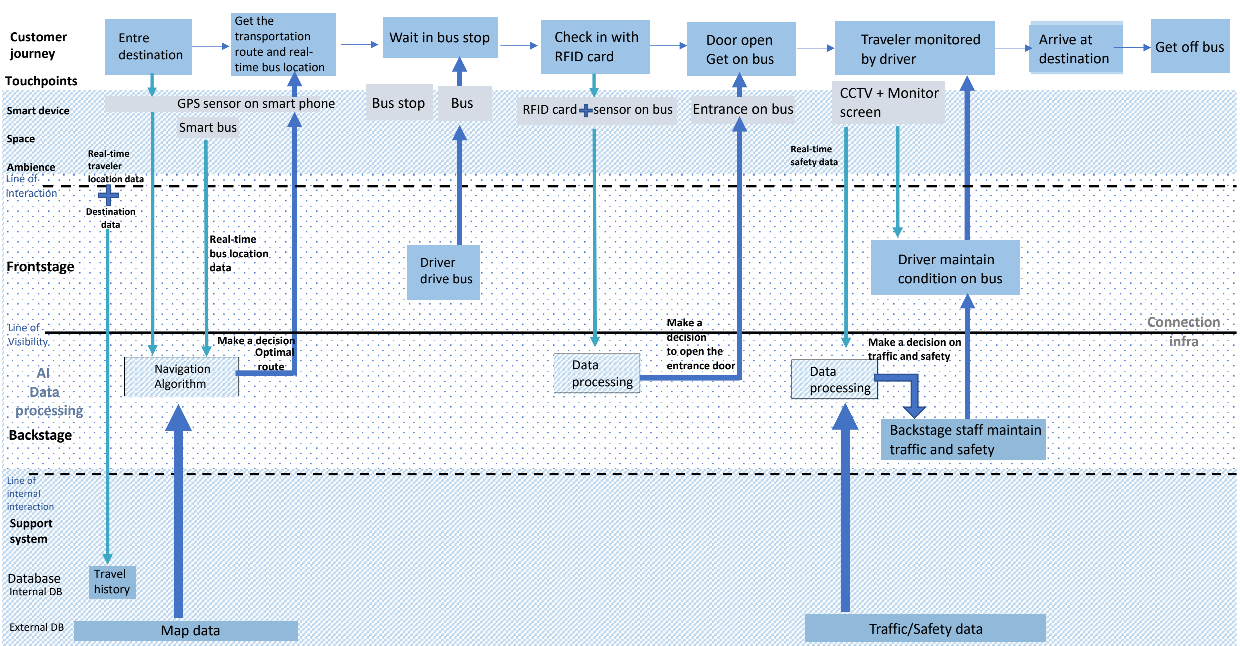

Figure 3 KKU Smart Mass transportation

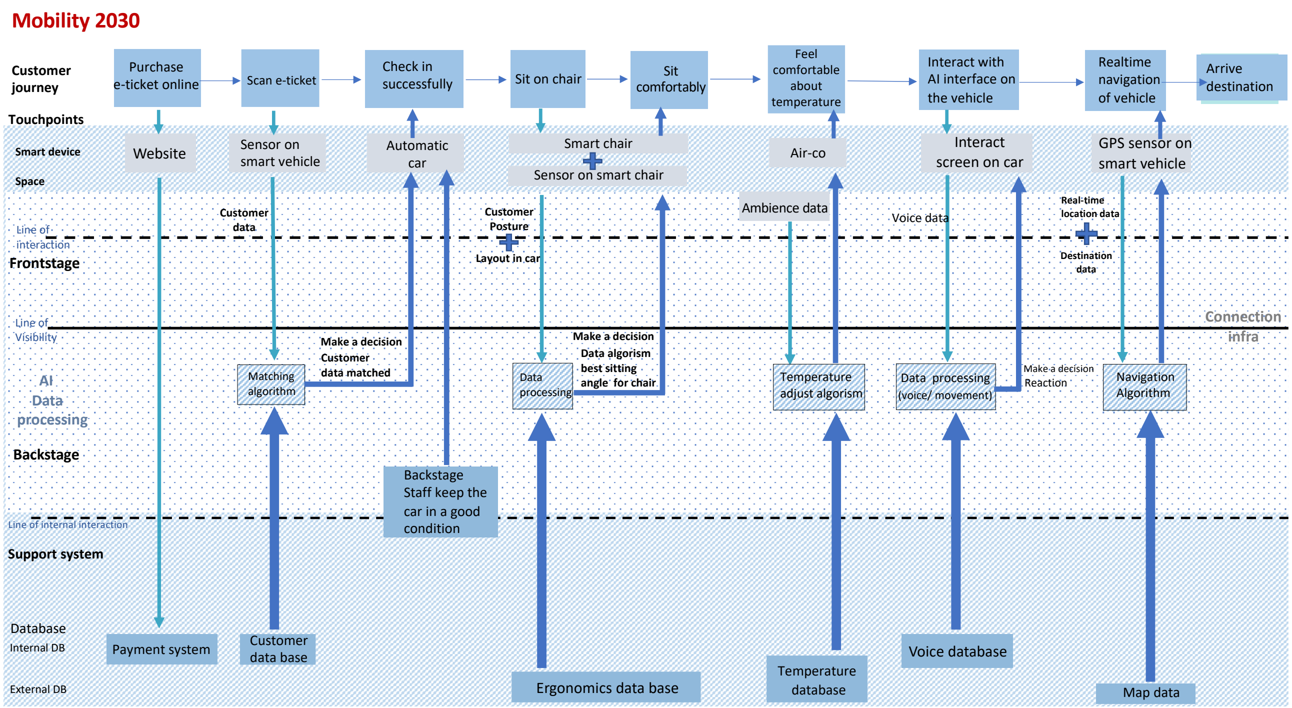

Figure 4 Mobility 2030

Results

During the qualitative analysis the authors intended to categorize the observed items according to the initial SSBS framework. The analysis enabled us to demonstrate the relationship of each element within the smart mobility services. The following findings are the important points that were achieved from the case analyses.

First, figures 2, 3 and 4 were created, which are the smart mobility scenarios according to the initial SSBS framework for the three respective cases based on the videos. Case 1 is the future mobility service of city Tampare. It integrates the mobility services of the smart bus and the smart bike to enable travelers to travel environmental-friendly. Case 2 features the KKU Smart Mass Transportation system, and it is a project under green and smart campus vision aiming to deliver smart mobility services to students and teachers by utilizing an intelligent bus. The monitoring and controlling actions in this smart mobility service provide a convenient service and maximize security for commuters, as well as improve environmental friendliness. Case 3, the mobility in 2030, is the ideal scope of smart mobility services in 2030. It intends to set up the future vision of smart mobility services based on the collaboration with human-AI centric smart services, including voice and movement detection when the user interacts with the AI system and autonomous self-driving.

Second, the authors defined the dimensions reflecting characteristics of the smart service implementation, i.e. the smart device, AI, database involved in support process and the connection infra. They all show the process how the user experience and AI integrate with one another.

Third, it was found that the common finding for the three cases is that the smart devices are the primary touchpoints, which connect users with the service provisional process. Specifically, space and ambience work together with the smart device to build the connection with users. They influence the smart device, and the smart device plays the role of sensing and actuating when working with these two touchpoints. In case 3 (figure 4), the ambience part is that the ambient sensor senses the real-time environment temperature. It transfers the data through the connection infra from the external temperature database to the data processing section.

Fourth, based on the first two findings above, it was concluded that touchpoints play a critical aspect within the interactive relationship between users and AI section. Touchpoints like smart devices, space and ambience which environments aspects occur in an omnipresent way. Smart devices act as the boundary products that interact directly with the users, sense or monitor users' behavior, collect the data and transfer them to the AI part to make the decision to act on the smart device. Meanwhile, the database also influences the AI as well as the smart device. AI plays the mediating role between the touchpoint and database.

Consequently, the authors found that in all three cases, the user experience covers a wider perspective, including that of the customer, frontstage employees and backstage employees. The front and backstage employees are both the service providers and users. The support process is how the technology support department enables the delivery of the smart service.

Discussion

This study demonstrates a correlation between user experience and AI, focusing on the process of how users use and interact with the smart service. In particular, the author proposed the initial SSBS framework and updated it by using this framework to analyze three smart mobility services. From the case analysis, it is can be found that the dimensions of SSBS framework which show the integrative process of user experience and AI; touchpoints are the significant part interacting with human users and AI; the smart device is the primary touchpoint of the three smart mobility services, space and ambience work with smart devices to communicate with users; AI has the intermediate impact between touchpoints and database, because it could process the data collected from the user and environment interaction with touchpoints and compile them to a database. Similarly, the database transfers the internal or external data to the AI for supporting the decision making and reflect on the decisions sent to touchpoints; the customer, frontstage employees and backstage employees are all service users representing user experience.

According to the results above, the User-AI decisions making loop was achieved and represented in figure 5, which shows a systematic view of AI-enabled smart services. The users involving customers and front and backstage employees interact with touchpoints and transfer the real-time data and feedback to AI for making multiple decisions. After that, touchpoints receive the decisions and transform them to users. As a result, users make decisions according to the multiple options provided by the AI. In this loop, touchpoints fully reflect the fountain of connections. User actions can influence and be influenced by the interaction between users and touchpoints. The ubiquitous database could affect and also be affected by the interaction between user action and touchpoint. Once the user action change, the AI system receives the changed data immediately, meanwhile the database transfers relevant data to the AI part. Different data processing appears to make different decisions which will eventually influence user actions. Users have the authority to accept or decline the decision made by the AI as the smart services with a high degree autonomy. Smart technology is supposed to serve users and follow their commands. However, most users feel insecure as they lose the control and power over these smart services and autonomous smart services that make decisions on their own that disregard users' command.

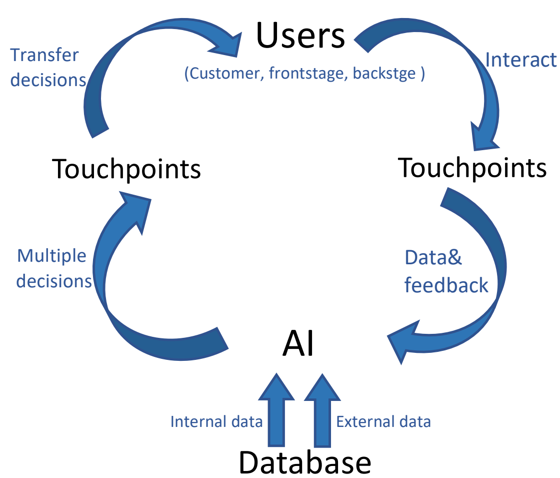

Figure 5 User-AI decisions making loop

Based on the findings, the authors updated the SSBS framework, which can be found in Figure 6. It offers an improved explanation of the relationship between the users and the smart service provisional process. This relationship is the interaction between users such as a customer, frontstage employee, backstage employee and smart service characteristics such as touchpoints, AI and database. Figure 6 demonstrates the interaction process through five steps. In step 1, users interact with a touchpoint, which generates real-time interactive data. In step 2, the data is transferred to the AI section to perform the data processing, the related data can come from internal or external databases at the same time. In step 3 and step 4, the data is processed using AI algorithms and the decision suggestions are made and transferred to touchpoints. In step 5 touchpoints receive the decision suggestions and interact with a user who is involved in the smart service process.

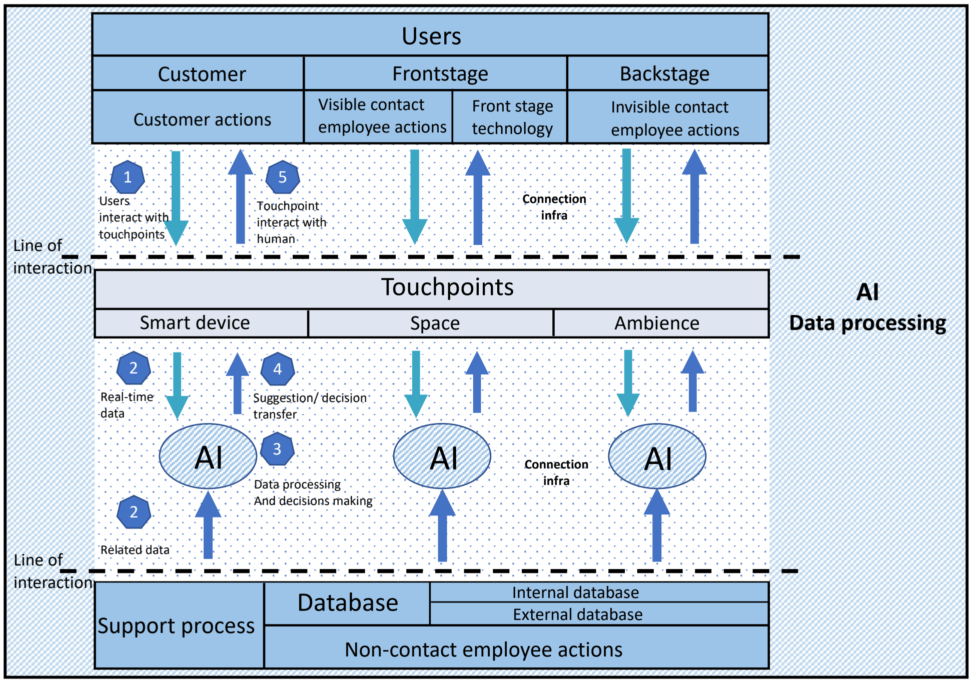

Figure 6   Updated SSBS framework

Conclusions

With the advanced development of smart service and the requirements of improving its adoption, it is important for service designers to not only focus on the technology aspects but also on the user experience perspectives. In line with the definition of smart services, services tailored to specific user needs with the help of data and intelligent processing is essential and necessary. It requires a deeper and more intimate understanding of the users, their contexts of use and the intelligent processing of these emergent data. This understanding could be further processed to enable smart inventions that support the users on how they interact with this technology regularly. Under these circumstances, the authors proposed a dynamic 'Smart Service Blueprint Scape'(SSBS) framework, which can guide service designers to maintain the service design and the technology development at the same time.

Based on the proposed framework, this research analyzed three smart mobility service cases critically. Through a series of qualitative cases studies, the values of an SSBS framework can be recognized. The authors identified the dimensions reflecting the characteristics of a smart service, i.e. the connection among the smart device, the AI and the database inside the support process. The users in a smart service delivery process are the customers and front and backstage employees. They interact with the touchpoints, which serve as the interactive role between users and AI. The touchpoints transfer the data when interacting with these users and simultaneously receive the decisions from AI algorithms. AI has the intermediate role, it maintains the intelligence of the smart service and it helps to create a systematic overview. The smart device, space and ambience in the touchpoints are the connection between the users and the intelligence part of the smart service. The data recording, data actuation, and AI algorithms are imperative to make the services smart.

Currently, in the smart service design field, the design process between user experience and technology perspectives are fully separate. There is a lack of connection between the user experience and technology invention. Designers used to only focus on the users' side instead of considering the technological aspects, on the other hand, technologists are standing only beside the technology. Under the guidance of this framework, the role of designers tends more towards a coordinator who is maintaining the balance of the smart service and user acceptance. They communicate with users, service providers, technology experts and other stakeholders to make sure their insights are smoothly communicated within a smart service delivery process.

Following this discussion, the framework will allow iterative reflections from two different departure points and eventually create a harmony between technology and user experience. It explores an approach which applies user experiences to inform technology and smart service design, meanwhile, it could also serve as an inspiration for technologists to create meaningful user experiences through smart service design.

Furthermore, this study also comes up with a mixed approach to the integration of user experience and technology application which is similar to the term called technology-inspired design. The idea is to get users involved at the beginning of the design process to co-shape the experience. Meanwhile, when exploring the user experience, the technological aspects can also be included in this process and inspire the users' experience. In other words, designers can focus on designing user experience followed by the related technology elements that are required to implement these, or on creating technology advances that can contribute to meaningful user experience.

Nevertheless, some limitations have also been identified in refining the improved framework. These are, the SSBS framework elements which are related to the reasoning part, the detailed description of how the AI technology should be used during the service process and how the data being dealt with by AI algorithms should be enriched.

Moreover, in the next phase of the research study, the focus will be on how this framework informs technology-inspired experience design and how the smart service design can be guided by the SSBS framework.

References

Akaka, M., Vargo, S., & Schau, H. (2015). The context of experience. Journal Of Service Management, 26(2), 206-223. doi: 10.1108/josm-10-2014-0270

AlSheibani, S., Cheung, Y., & Messom, C. (2018). Artificial Intelligence Adoption: AI-readiness at Firm-Level. *Artificial Intelligence*, 6, 26. Retrieved from https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1036&context=pacis2018

Bajwa, D., Lewis, L., Pervan, G., Lai, V., Munkvold, B., & Schwabe, G. (2008). Factors in the Global Assimilation of Collaborative Information Technologies: An Exploratory Investigation in Five Regions. *Journal of Management* Information Systems, 25(1), 131-166. doi: 10.2753/mis0742-1222250106

Balta-Ozkan, N., Davidson, R., Bicket, M., & Whitmarsh, L. (2013). Social barriers to the adoption of smart homes. *Energy Policy*, 63, 363-374. doi: 10.1016/j.enpol.2013.08.043

Bellotti, V., & Edwards, K. (2001). Intelligibility and Accountability: Human Considerations in Context-Aware Systems. *Human–Computer Interaction*, 16(2-4), 193-212. doi: 10.1207/s15327051hci16234_05

Beverungen, D., Müller, O., Matzner, M., Mendling, J., & vom Brocke, J. (2017). Conceptualizing smart service systems. *Electronic Markets*, 29(1), 7-18. doi: 10.1007/s12525-017-0270-5

Biehl, M., Prater, E., & McIntyre, J. (2004). Remote repair, diagnostics, and maintenance. *Communications of The ACM*, 47(11), 100-106. doi: 10.1145/1029496.1029501

Bitner, M., & Crosby, L. (1989). *Designing a winning service strategy* (7th ed., pp. 30-33). Chicago, Ill.: American Marketing Association.

Bitner, M. (1992). Servicescapes: The Impact of Physical Surroundings on Customers and Employees. *Journal of Marketing*, 56(2), 57. doi: 10.2307/1252042

Bitner, M., Ostrom, A., & Morgan, F. (2008). Service Blueprinting: A Practical Technique for Service Innovation. *California Management Review*, 50(3), 66-94. doi: 10.2307/41166446

Business Tampere. (2017, September 15). *Smart Mobility-Tampere, Finland [Video file]. Retrieved from* https://www.youtube.com/watch?v=dvMD2jry_18&list=PLbgDXzRJmpvsb25eVfIVd0wf9X0OQTGf3&index=2&t=0s

Choudhary, S., & Patkar, U. (2016). DATABASES FOR ARTIFICIAL INTELLIGENCE. Retrieved 4 February 2020, from https://www.ijcsmc.com/docs/papers/March2016/V5I3201617.pdf

CJ Haughey, C. (2019). How to Improve UX With AI and Machine Learning - Springboard Blog. Retrieved 6 March 2020, from https://www.springboard.com/blog/improve-ux-with-ai-machine-learning/

Davenport, T. H., & Kirby, J. (2016). Just how smart are smart machines? *MIT Sloan Management Review*, 57(3), 21-25.

Dearing, J. (2009). Applying Diffusion of Innovation Theory to Intervention Development. *Research On Social Work Practice*, 19(5), 503-518. doi: 10.1177/1049731509335569

Ellabban, O., & Abu-Rub, H. (2016). Smart grid customers' acceptance and engagement: An overview. *Renewable And Sustainable Energy Reviews*, 65, 1285-1298. doi: 10.1016/j.rser.2016.06.021

Forlizzi, J., & Battarbee, K. (2004). Understanding experience in interactive systems. *Proceedings Of The 2004 Conference On Designing Interactive Systems Processes, Practices, Methods, And Techniques - DIS '04*, 261-268. doi: 10.1145/1013115.1013152

Guszcza, J., Lewis, H., & Evans-Greenwood, P. (2017). Cognitive collaboration: Why humans and computers think better together. *Deloitte Review*, 20, 8-29.

Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: foundations and developments. *Electronic Markets*, 25(3), 179-188. doi: 10.1007/s12525-015-0196-8

Haddon, L. (2003). *Domestication and mobile telephony* (pp. 43-56). New Brunswick, N.J.: Transaction Publishers.

Hassenzahl, M., & Tractinsky, N. (2006). User experience - a research agenda. *Behaviour & Information Technology*, 25(2), 91-97. doi: 10.1080/01449290500330331

Huang, M., & Rust, R. (2017). Technology-driven service strategy. *Journal of The Academy of Marketing Science*, 45(6), 906-924. doi: 10.1007/s11747-017-0545-6

Jarrahi, M. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons*, 61(4), 577-586. doi: 10.1016/j.bushor.2018.03.007

Kang, H. J., Kwon, G. H., Kim, B., & Park, E. (2017). A Framework for Smart Servicescape: *A Case of Smart Home Service Experience.* IASDR 2017 (International Association of Societies of Design Research), 1665-77.

Kang, H., Kim, B., & Kwon, G. (2018). The Smart Servicescape Framework in Smart Home HealthcareService Experience. 21Stdmi: *Academic Design Management Conference*, 1402-1411. Retrieved from https://www.researchgate.net/publication/327814243_The_Smart_Servicescape_Framework_in_Smart_Home_Healthcare_Service_Experience

Kazemzadeh, Y., Milton, S., & Johnson, L. (2015). A Comparison of Concepts in Service Blueprinting and Process Chain Network (PCN). *International Journal of Business And Management*, 10(4), 13. doi: 10.5539/ijbm.v10n4p13

Keh, H., & Pang, J. (2010). Customer Reactions to Service Separation. *Journal of Marketing*, 74(2), 55-70. doi: 10.1509/jm.74.2.55

Khon Kaen University. (2015, September 16). *KKU-Smart Mass Transportation [Video file]. Retrieved from* https://www.youtube.com/watch?v=Iz9_gaVko2g&list=PLbgDXzRJmpvsb25eVfIVd0wf9X0OQTGf3&index=19

Kibria, M., Nguyen, K., Villardi, G., Zhao, O., Ishizu, K., & Kojima, F. (2018). Big Data Analytics, Machine Learning, and Artificial Intelligence in Next-Generation Wireless Networks. *IEEE Access, 6, 32328-32338.* doi: 10.1109/access.2018.2837692

KPMG. (2017, April 20). *Mobility 2030: Beyond transportation [Video file]. Retrieved from* https://www.youtube.com/watch?v=4B7mZFU2sB4&list=PLbgDXzRJmpvsb25eVfIVd0wf9X0OQTGf3&index=3

Landau, M., Kay, A., & Whitson, J. (2015). Compensatory control and the appeal of a structured world. *Psychological Bulletin*, 141(3), 694-722. doi: 10.1037/a0038703

Lim, C., & Kim, K. (2014). Information Service Blueprint: A Service Blueprinting Framework for Information-Intensive Services. *Service Science*, 6(4), 296-312. doi: 10.1287/serv.2014.0086

Liu, H., Ning, H., Mu, Q., Zheng, Y., Zeng, J., & Yang, L. et al. (2019). A review of the smart world. *Future Generation Computer Systems*, 96, 678-691. doi: 10.1016/j.future.2017.09.010

MacKenzie, D., & Wajcman, J. (1999). The social shaping of technology. Milton Keynes: Open University Press.

Meuter, M., Bitner, M., Ostrom, A., & Brown, S. (2005). Choosing among Alternative Service Delivery Modes: An Investigation of Customer Trial of Self-Service Technologies. *Journal of Marketing,* 69(2), 61-83. doi: 10.1509/jmkg.69.2.61.60759

Mollenkopf, H., Marcellini, F., Ruoppila, I., Szeman, Z., Tacken, M., & Wahl, H. (2004). Social and behavioural science perspectives on out-of-home mobility in later life: findings from the European project MOBILATE. *European Journal of Ageing*, 1(1), 45-53. doi: 10.1007/s10433-004-0004-3

Norman, D. (2009). *The design of future things*. New York: Basic Books.

Peng, G., Nunes, M., & Zheng, L. (2016). Impacts of low citizen awareness and usage in smart city services: the case of London's smart parking system. *Information Systems And E-Business Management*, 15(4), 845-876. doi: 10.1007/s10257-016-0333-8

Pennington, B., Chapman, S., Fry, A., Deschenes, A., & McDonald, C. (2016). Strategies to Improve the User Experience. *Serials Review*, 42(1), 47-58. doi: 10.1080/00987913.2016.1140614

Rantanen, T. (2013). Promoting Mobility in Older People. *Journal of Preventive Medicine & Public Health*, 46(Suppl 1), S50-S54. doi: 10.3961/jpmph.2013.46.s.s50

Rogers, E. (1995). *Diffusion of innovations* (3rd ed., p. 13*).* New York: Free Press.

Rogers, E. M. (2010). *Diffusion of innovations*. (4th ed., p.15).Simon and Schuster.

Russell, P., & Norvig, S. (2002). *Artificial Intelligence: A Modern Approach* (2nd ed., p. 374). Paperback Hall.

Scott, S., Plotnikoff, R., Karunamuni, N., Bize, R., & Rodgers, W. (2008). Factors influencing the adoption of an innovation: An examination of the uptake of the Canadian Heart Health Kit (HHK). *Implementation Science*, 3(1). doi: 10.1186/1748-5908-3-41

Shostack, G. (1984). *Designing Services that Deliver. Harvard Business Review, 133-139. Retrieved from* https://strategicdesignthinking.files.wordpress.com/2012/11/hbr-shostackpdf.pdf

Siegel, R., & Kennedy, M. (2016). 20 Years Later, Humans Still No Match For Computers On The Chessboard. Retrieved 3 April 2020, from https://www.wlrn.org/post/20-years-later-humans-still-no-match-computers-chessboard

Siverstone, R., & Haddon, L. (1996). Design and the domestication of information andcommunication technologies: Technical change and everyday life. In R. Siverstone &R. Mansell (Eds.), Communication by design: The politics of information and communication technologies (pp. 44-74). Oxford, UK: Oxford university press.

Siverstone, R., Hirsch, E., & Morley, D. (1992). Information and communication technologies and the moral economy of the household. In R. Silverstone &E. Hirsch (Eds.), Consuming technologies; media and information in domestic spaces. London, UK: Routledge.

Surprenant, C., & Solomon, M. (1987). Predictability and Personalization in the Service Encounter. Retrieved 18 February 2019, from https://www.researchgate.net/publication/279335745_Predictability_and_Personalization_in_the_Service_Encounter

Tacken, M., Marcellini, F., Mollenkopf, H., Ruoppila, I., & Széman, Z. (2005). Use and acceptance of new technology by older people. Findings of the international MOBILATE survey: 'Enhancing mobility in later life'. *Gerontechnology*, 3(3). doi: 10.4017/gt.2005.03.03.002.00

Wünderlich, N., Heinonen, K., Ostrom, A., Patricio, L., Sousa, R., Voss, C., & Lemmink, J. (2015). "Futurizing" smart service: implications for service researchers and managers. *Journal of Services Marketing*, 29(6/7), 442-447. doi: 10.1108/jsm-01-2015-0040

Wünderlich, N., Wangenheim, F., & Bitner, M. (2013). High Tech and High Touch. *Journal of Service Research*, 16(1), 3-20. doi: 10.1177/1094670512448413

Yang, H., Lee, W., & Lee, H. (2018). IoT Smart Home Adoption: The Importance of Proper Level Automation. *Journal of Sensors*, 2018, 1-11. doi: 10.1155/2018/6464036

Zerilli, J., Knott, A., Maclaurin, J., & Gavaghan, C. (2019). Algorithmic Decision-Making and the Control Problem. *Minds And Machines*, 29(4), 555-578. doi: 10.1007/s11023-019-09513-7

Zhu, Z., Nakata, C., Sivakumar, K., & Grewal, D. (2007). Self-service technology effectiveness: the role of design features and individual traits. *Journal of The Academy of Marketing Science*, 35(4), 492-506. doi: 10.1007/s11747-007-0019-3

Zomerdijk, L., & Voss, C. (2009). Service Design for Experience-Centric Services. *Journal of Service Research*, 13(1), 67-82. doi: 10.1177/1094670509351960