813

Accelerating Retail-Innovation Design for Smart Services via Foresight Approach and Case-Based Design

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Abstract. The fourth industrial revolution (Industry 4.0) is taken as a dramatic upgrade of the third revolution. Compared with prior industrial revolutions, Industry 4.0 put more focus on the creation of networks and interconnectivities among existing assets based on Internet of things (IoT). This study attempts to depict inno-service concepts with the commonality in different categories based on IoT technology and the concepts of cyber-physical systems (CPS) from both the problem-analysis side and resolution-analysis perspective. The problem-analysis utilizes a socio-economic needs analysis, which compromises shopping district categories analysis and categories needs analysis, to obtain the main categories of the shopping district and key problems of it. In addition, the resolution-analysis utilizes a case-based design approach, which compromises case recall and case adapt to refer to the related IoT cases, and then smart shopping themes are proposed. Based on the socio-economic needs analysis including the development in the practical industry, literature of shopping-mall management and the district survey, this research identified six categories for a mega city's major district functions, namely (1) tourism, MICE (meetings, incentives, conferencing, exhibitions) and accommodations, (2) food, beverage and supermarkets, (3) cultural and creative sectors and bookstores, (4) furniture, furnishings and appliances, (5) clothing, accessories and cosmetics, (6) cinema, recreation and sports. In addition, based on the 54 smart-service cases in the global environment from the six classifications, the most valuable solutions from the case base are adapted and reused to meet the current needs and situation. Thus, six smart shopping themes are designed as a CPS-based services among the above six classifications, including (1) Ubiquitous cultural creative street side integration services, (2) Smart food and restaurant services, (3) Future make-up and fast fashion services, (4) Smart living experiential marketing services, (5) Entertainment-based innovative services, (6) MICE Integrated Services. The results can be utilized for researchers to better find more foresight themes efficiently and effectively and for firms to adopt these six new concepts to design the detailed service specification with business concept innovation or business process improvement.

Keywords. Internet of Things (IoT), cyber-physical systems (CPS), Industry 4.0, smart shopping, case-based design, foresight research, retail-innovation design

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Introduction

The fourth industrial revolution (Industry 4.0, I 4.0) [1] is the next incremental advancement for industry. This revolutionary trend is enabled with micro intelligence such as cyber-physical systems (CPS), Internet of Things (IoT), cloud computing, and big data analytics. In this evolutionary economy, companies may differ in terms of their innovation behavior. Firms and organizations within the same industry are argued to adopt the same technological and knowledge conditions, which drive correlated behavior. To achieve I 4.0, smart systems or ecosystems, such as smart manufacturing, smart transportation and smart meter and smart living, consisting of CPS and the IoT are built and integrated. In this research, the novel service-based, CPS-based themes are eager to be carried out through IoT to IoS (Internet of services) [1].

Foresight is "a university human capacity which allows people to think ahead and consider, model, create and respond to, future eventualities" [2]. Foresight is, however, usually an unconscious thinking process. In a business-organizational context, foresight is not necessarily recognized or universal [3]. It generally needs to be put in the specific scope, supported by specific methodologies, to develop an organizational capacity for foresight, or so-called business foresight [2, 3, 4]. The future challenge in the research of innovation systems is to see and understand what the strategic role is and actual importance of foresight systems in firm-level innovation processes [5, 6]. It is hoped that this work would help narrow the gap between foresight research and innovation systems research. Thus, we proposed a hybrid approach of the foresight research incorporated with case-based design.

This paper is based on the various outputs obtained from a smart IoT-based commerce district development project conducted in Taiwan. After three years (2013-2015) of systematically business foresight research, nearly 25 IoT-based innovative services were carried out as Proof of Services (POS). In 2015, 15 smart shopping themes were designed and proposed to lead the future applications and scenarios of the shopping mall in Taipei Xin-Yi district in the six categories for a mega city's major district functions. The purpose of the research is to understand the context and problems of a smart shopping field as a specific aspect to figure out the suitable smart shopping themes for better living scenarios. According to the research outcomes, the proper system design and operation teams will be selected, so as to develop the concepts and establish the smart shopping themes as a real demonstration application in the specific space.

1. Case based reasoning and Case based design

1.1. Case based reasoning

The concept of CBR refers to a methodology of using the prior experiences to infer and deal with current problems of similar features. It is a computer technique that is attracting increasing attention in many pieces of research in different domains. CBR combines the knowledge-based and memory-centric support philosophy with a simulation of human reasoning while using experience [7, 8]. The system adopts some specific principles or rules to solve the current problems in the same way that people do, to ensure consistency of response when solving similar problems. The prior experiences or cases are stored in a specific database. Since the system learns from its

past experiences, this is called a dynamic memory-based learning system. By searching in the past, similar problems provide solutions through a process of inference. Moreover, as the system continues to grow, its ability to deal with the problems increases. CBR process includes five steps, namely case represent, case retrieval, case reuse, case revise, case retain [7].

1.2.Case based design

Case based design (CBD), which is a concept of case based reasoning (CBR) in design, is an approach based on CBR to support the design with problem solving [8]. It is also the process of creating a new design solution by combining and/or adapting previous design solutions. There are two major processes in the framework of a CBD model, namely the case-recall process and the case-adapt process [8]. CBD can enhance creativity for designers by the solution searching mechanism in finding innovation ideas.

- The case-recall process
  The process includes indexing, retrieval and selection. While encountering a new problem, we can index and retrieve previous cases from case base via key features. Then, the retrieval cases are selected by the ranking of case-similarity.
- The case-adapt process
  The process includes modification and evaluation. Modifying source case so that it can fit the new problem by comparing the useful design and problem-solving information. After evaluation, put new solution into case base.

2. Research Framework

Due to IoT technology is an advanced field, we use multidisciplinary research framework (see Figure 1) to achieve the research objectives. Socio-economic needs analysis, namely shopping district categories analysis and categories needs analysis will be taken for problem analysis. In addition, case-based design is taken as the approach for resolution analysis. By these two dimensions of analysis, we attempt to find the main categories and opportunities, key problems and customer's unsatisfactory points and then refer to and adapt the corresponding innovative-service cases with IoT to propose the smart-shopping themes.

3. Research outcomes and findings

For knowing and developing the IoT-related innovative services, this research focuses on the scope of smart shopping to find out the future themes and blueprints to lead industrial service providers, device providers, and service integrators to explore possible topic as a value-chain team. Thus, more and more applications can carry out to the service industry among our surrounding. Industries can form an innovative eco-system based on IoT. In this paper, foresight research, namely socio-economic needs analysis will carry out 6 domains and their main issues (or domain needs). By collecting 54 global service innovation cases and adapting and transforming the cases [8, 9] into the local ones, we propose 15 themes of internet of services in the 6 domains.
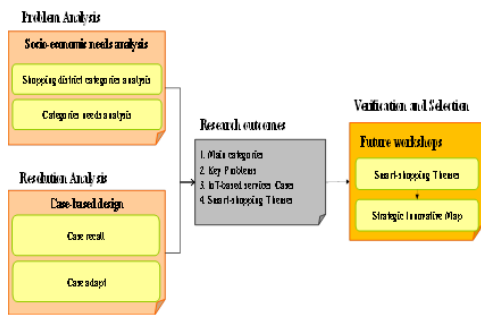
Figure 1. Research Structure.

Figure 2. Major categories of shopping malls.

3.1. Socio-economic needs analysis

3.1.1. Discovering main domains

A distinguished shopping mall plays an integrated role for a city's commercial district, especially when building a smart city. For discovering main domains of shopping mall, we conduct a practical investigation of 12 distinguished shopping malls in the main business area in Taipei city, Tainan city and Kaohsiung city, including Taipei 101, Att 4 FUN, Unified Hankyu, Xinyi Eslite, Lin department store, Fareast Mall, Shin Kong Mitsukoshi (SKM) A4, SKM A8, SKM A9, SKM A11, Regent Taipei, Taipei International Convention Center. The practical investigation was conducted to observe and analyze the online service, environment and facility, major brand and differential service and promotion activities. After the practical investigation, we discover the one specific six categories and one generic category of the shopping mall functionality for a mega city district. The discovered 7 categories (see Figure 2) for a mega city's major district functions, namely (1) tourism, MICE (meetings, incentives, conferencing, exhibitions) and accommodations, (2) food, beverage and supermarkets, (3) cultural, creative and bookstores, (4) furniture, furnishings and appliances, (5) clothing, accessories and cosmetics, (6) cinema, recreation and sports (7) parking and public information services. The first six categories are the specific categories that can be treated as a unique position to bring marketing, and the seventh one is the generic one.

3.1.2. Finding Key Problems

For the purposes of understanding the customers' requirements and user behaviors [10], we conducted a survey of customer shopping behavior with central location test (CLT) method from 1,050 questionnaires. Random sampling was applied to this study. About the issue of "find a place", parking problem (34.4%) is the top concern issue. About the issue of "find/ buy products", "counter staffs' over-aggressive introduce" (13.3%) and "required heavy lifting after shopping" (13.1%) are the most concern issue. Moreover, meal experience is the category with the highest inconvenience of negative experience. "Having seats after meal-ordering at food court"," "Knowing available space in advance" and "Worrying about placeholder items missing" are the most concern problems in this category. Other detailed survey results about customers' inconvenience are listed in Table1. Some other findings may be meaningful for understanding the customers' behavior. The proportion of respondents in Taipei

Business District was significantly was significantly higher than that of the other two business districts (Tainan and Kaohsiung) in terms of "watching movies", "visiting bookstores" and "course activities". In Taipei's business district, the percentage of respondents who went to the business district attempt to search for relevant information before going to business district was significantly higher than those of the other two business districts. The proportion of respondents in the Kaohsiung's business district was significantly higher than that other two business districts in terms of "having meals", "attending arts and culture activities." After the survey, we conclude three major issues of customer's inconvenience to shop in business districts: "insufficient attractiveness to appeal to visitors", "too many service fragments on the customer journey", and "offline attractiveness need to be higher than online shopping to reduce online shopping's threats".

Table 1. Survey results of customers' inconvenience.

| Issues	Customers' inconvenience	percentage
Find a place	Parking is not available	34.4%
	Cannot find specific brand shop	10.6%
Find/buy products	Counter staffs over-aggressive introduce	13.3%
	Required heavy lifting after shopping	13.1%
	Cannot find proper brand goods	11.4%
Make shopping decision	Do not like to shop without discounts	21.3%
	Friends' comments are required	13.2%
Watching movies	Long queuing while buying tickets	10.6%
Meal experience	Having seats after meal-ordering at food court	43.3%
	Knowing available space in advance	27.6%
	Worrying about placeholder items missing	22.4%

3.2. Case-based design

For using the concepts of case-based design, we conduct a case finding and collection from different countries to find the opportunity and study for the attributes and context of each case. We collected 54 inno-service cases based on Internet of things by our research team according to six categories (see Figure 3). These case base can be utilized in the design for service themes by case-recall process and case-adapt process.

After the practical case survey and analysis, we conduct the expert panel approach with research team members to consider the different issues and customer requirements and then propose and conceptualize six new service themes, namely (1) Ubiquitous cultural creative street side integration services, (2) Smart food and restaurant services, (3) Future make-up and fast fashion services, (4) Smart living experiential marketing services, (5) Entertainment-based innovative services, (6) MICE Integrated Services. The six new concepts of service themes (see Table 2) consist of 15 inno-services for the six categories The IoT-based services of the six categories and themes are summarized in Table 2 and are described as follows.

Table 2. IoT-based services of the six categories

Categories	New service themes	Inno-services with IoT
Cultural, creative and bookstores	Ubiquitous cultural creative street side integration services	† Timeline and location-guidance service for Cultural and creative performance † Landmark-oriented interactive service † Smart street bookcase and face-recognition book recommendation service
Food, beverage and supermarket	Smart food and restaurant services	† Smart food queuing management and reminder service † Meal and instant food integration marketing † Fresh ingredients cooking and bundle-selling service
Clothing accessories and cosmetics	Future make-up and fast fashion services	† In-store smart clothing shopping service † Automatic make-up service on demand
Furniture, furnishings and appliances	Smart living experiential marketing services	† Home furnishings and appliances visiting experience transferring into bonus-points service † Augmented reality display and demo service
Cinema, recreation and sports	Entertainment-based innovative services	† Personalized adaptive advertising † Virtual personalized sports coach
Tourism, MICE and accommodations	MICE Integrated Services	† Service fragment self-scheduling services † Location-based recommendation signage with map service † Interactive social information exchange service

Figure 3. Case base of IoT-based services.
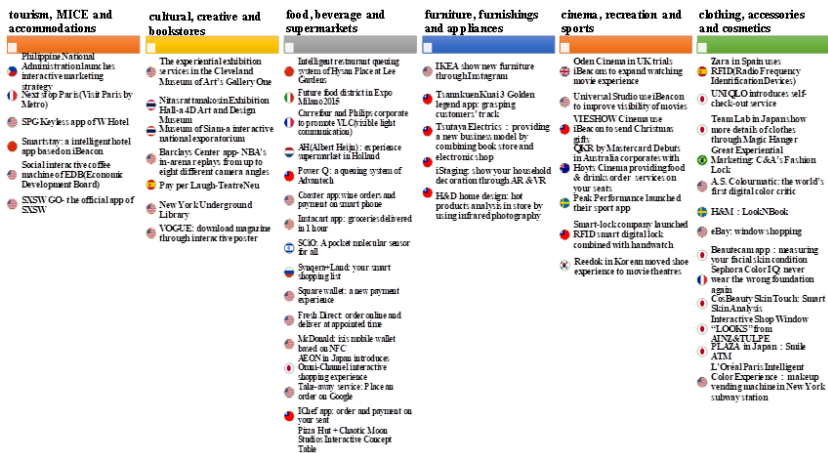
The concepts of each inno-services are introduced as follows:

(1) Timeline and location-guidance service for cultural and creative performance: to search the timeline and location of the cultural and creative performances at the business district on smartphone.

(2) Landmark-oriented interactive service: to gather customer by compelling landmarks and multi-dimensional interactive services.

(3) Smart street bookcase and face-recognition book recommendation service: to equip the street corner with the virtual book wall, e-book preview downloading and guidance to shop services to conduct the bookstore O2O (online to offline) shopping guidance efficiently.

(4) Smart food queuing management and reminder service: to provide the food court or restaurant in the shopping mall with the reservation and queue reminder service.

(5) Meal and instant food integration marketing: to get the shopping behaviors of consumers by checking their food traceability and purchase records for demassified marketing.

(6) Fresh ingredients cooking and bundle-selling service: to integrate the functions of the supermarkets and restaurants in the shopping mall for customized cooking by providing the bundle-selling service of the fresh ingredients.

(7) Personalized adaptive advertising: to identify the facial features or phone records for making the personalized and accurate movie advertising.

(8) Virtual personalized sports coach: to collect the sports, recreation, training and body information with the equipment and provide suggestions to the sport menu and scheduling services.

(9) Service fragment self-scheduling services: to integrate the information of the fragmented time during the exhibition by App and recommend the nearby attractions, restaurants and recreations, and provide self-scheduling service of the day.

(10) Location-based recommendation signage with map service: to recommend the attractions, activities and location information near the residence using the interactive signage.

(11) Interactive social information exchange service: to provide the access of the e-DM, exchanging of business card and interactive instructions during the exhibition.

(12) Home furnishings and appliances visiting experience transferring into bonus-points service: to give the promotion to customers by their bonus-points which are accumulated by visiting and on-site experience the home furnishings.

(13) Augmented reality display and demo service: to provide customers with immersive experience of the home furnishings leveraging the VR technology.

(14) In-store smart clothing shopping service: to provide customers with the personalized adaptive advertising or contents and to guide the in-store shopping and routing.

(15) Automatic make-up service on demand: to support the immediate makeup self-service by selecting makeup style on the smart phone or interactive signage.

After designing the above new service themes, we held a workshop with 95 people and introduce the industrial background, issues and service concepts. After that, we had more discuss with experts and got 47 available questionnaires. We have some statistics and make a strategic innovative map (as shown in Figure 4) including 4 quadrants based by the value of market attractiveness and the market acceptance. In the quadrant with high attractiveness (average higher than 5 scores) and high acceptance (average higher than 30%), there are six new service themes which are in the top right dimension of Figure 4.

4. Conclusions

IoT-based technologies, products and services will lead to a series of new strategic choices, such as how to create and acquis new value of IoT-based products or services, how to collect, use and manage large numbers of new data, and how to re-define and maintain the new channel relationship with traditional business partnership [11]. Under the situation of expansion of industry boundaries, enterprises should play what kind of new roles while facing the wave of business transformation is a crucial issue [12]. The research outcomes have the contributions to fit the above challenges. Firstly, the 6 categories with 6 service themes and 15 IoT-based inno-services are highly market-potential and can be taken as a knowledge base for practical use. The development of the above concepts can be conducted and transformed by the specific context of enterprises, especially the six highest potential IoT-based services in the top-right

quadrant of the strategic innovative map. Secondly, the retail-innovation design with foresight methods incorporating with case-based design is with novelty and verified with practical experience in Taiwan. The systematic approach is also with academic contribution and can enrich the design methods of reference about how to develop efficient IoT-based or CPS-based inno-services. By the innovative services and solutions, customers can feel the new scenarios with smartness, convenience and thoughtfulness.
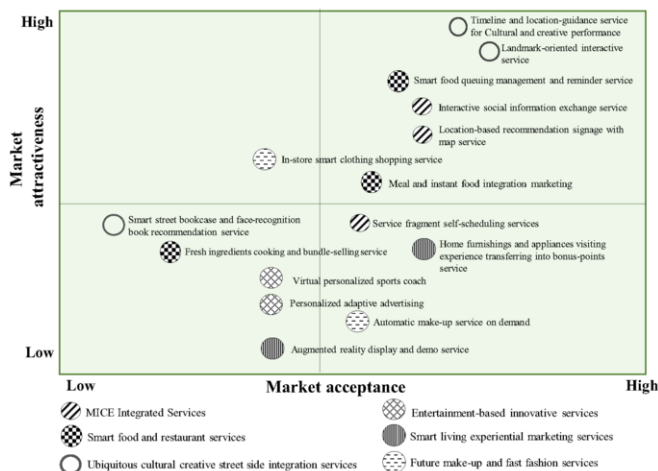
Figure 4. The four quadrants of the strategic innovative map.

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