Smart Product-Service System Innovation with User Experience: A Case Study of Chunmi

Ying Yu, Wen-Chi Kuo, Tung-Jung Sung

Abstract—The Product-Service System (PSS) has received widespread attention due to the increasing global competition in manufacturing and service markets. Today's smart products and services are driven by Internet of things (IoT) technologies which will promote the transformation from traditional PSS to smart PSS. Although the smart PSS has some of technological achievements in businesses, it often ignores the real demands of target users when using products and services. Therefore, designers should know and learn the User Experience (UX) of smart products, services and systems. However, both of academia and industry still lack relevant development experience of smart PSS since it is an emerging field. In doing so, this is a case study of Xiaomi's Chunmi, the largest IoT platform in the world, and addresses the two major issues: (1) why Chunmi should develop smart PSS strategies with UX; and (2) how Chunmi could successfully implement the strategic objectives of smart PSS through the design. The case study results indicated that: (1) the smart PSS can distinguish competitors by their unique UX which is difficult to duplicate; (2) early user engagement is crucial for the success of smart PSS; and (3) interaction, expectation, and enjoyment can be treated as a three-dimensional evaluation of UX design for smart PSS innovation. In conclusion, the smart PSS can gain competitive advantages through good UX design in the market.

Keywords—Design research, smart PSS, user experience, user engagement.

I. INTRODUCTION

SERVITIZATION is becoming increasingly important for the manufacturing industry. According to the World Trade Organization's report—World Trade Report 2019: the trade in services was worth US$13.3 trillion in 2017, comprising approximately one third of global trade [26]. From the perspective of regional economies, the latest data from the World Bank show that the service added value in 264 countries accounted for approximately 65% of the GDP (Gross Domestic Product), among which the high-income countries accounted for about 65% (e.g., US, UK, JP), the middle-income countries about 53.867%, and the low-income countries about 39.293% [12]. Servitization is a global trend; it could constantly improve enterprise competitiveness, and become the main power of economic growth [7]. Therefore, an increasing number of manufacturers are integrating products and services to gain competitive advantages through the PSS [15] (e.g., Apple,

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Amazon, and Uber). At the same time, the world is standing on the edge of the third transformation of Information Technology. The IoT realizes the interaction and communication between different things through networks integrating hardware, software and computing equipment based on Information Technology. It has changed the mode by which manufacturers to create value for users [5], [19], and has promoted the PSS to a new level—the smart PSS [20].

Smart PSS is a popular topic for sustainability and business researchers [3], [4]. It could even help manufacturers make some achievements in the business and technology fields, but it is not widely used or accepted by mainstream users. The main reason is that the technology-centered approach often ignores the real demands of target users when using products and services [1], [9], [10], [18]. For example, although the robot's audio, visual, and emotional technology improved its communication ability, the design ignored the essence of interpersonal communication between humans, and eventually the company became insolvent. Thus, UX is seen as a competitive strategy in the smart field (e.g., ICT and IoT).

According to ISO 9241-210, the UX is defined as: "a person's perceptions and responses that result from the use or anticipated use of a product, system or service" [13]. A good UX not only satisfies the needs of the user, but also differentiates the products and services [18]. In other words, a better product/service experience is created through user needs to enhance competition. In addition, the design-oriented development focuses more on the understanding process and innovation from the perspective of users, rather than on aesthetics alone [4], [11]. Therefore, a smart PSS design should focus on user needs to improve product and service through UX [18].

To sum up, the smart PSS has attracted increasing attention from academic and industry researchers due to digitalization and servitization [6], [20], [25]. However, both academia and industry still lack relevant development experience of smart PSS since it is an emerging field [4], [21]. Therefore, this study adopted the case study approach to discuss Xiaomi's Chunmi, the largest IoT platform in the world, to understand how to innovate the smart PSS strategy with UX, so as to provide a reference for future academic and industrial researchers.

II. DEVELOPMENT OF PSS: TRADITIONAL PSS & SMART PSS

The SCP (Smart, Connected Product) was triggered by the transformation from traditional PSS to smart PSS, based on IT as an integral part of the product itself. In the technical aspect, the smart PSS has the capabilities of collecting, processing, and producing information to perceive the context and predict

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intention, and to provide services proactively [19], [23]. In the business aspect, smart PSS could improve interaction to realize co-creation between the user and the manufacturer, and satisfy highly personalized user needs. In general, the SCP is significant for identifying the differences between smart and traditional PSS. On the other hand, the IT-led PSS has three stages: (1) Conventional PSS; (2) IoT-enabled PSS; and (3) Smart PSS [20]. The following section provides further descriptions of each stage. First, conventional PSS focused on efficient delivery of information based on Internet-driven value creation, such as Internet TV which is based on IT to improve the quality of the picture, and to provide ways of paying for additional channels. Secondly, IoT-enabled PSS is based on conventional PSS with IoT. Information is collected and interchanged among the network devices, and different products are coordinated. For example, a smart home can realize remote control between appliances through collecting and delivering information. Thirdly, smart PSS is enabled by the SCPs, whereby IT is embedded in the product itself for value creation. It is focused on interactive relationships in different contexts between user and product by SCPs. For example, Amazon Echo can communicate with the user by voice, and can connect different SCPs to provide services, such as cleaning, music, and shopping through contextual perception.

III. UX & SMART PSS

According to ISO 9241-210, the UX is defined as: "a person's perceptions and responses that result from the use or anticipated use of a product, system or service." Heikkinen and Määttä [18] proposed that UX focuses on the perceptions of the entire life cycle of the product, service or system, and has two advantages: (1) in the user's opinion, UX can meet the user's needs of enjoyment when using a product and service; (2) in the manufacturer's opinion, UX can innovate business by differentiating products/services, increasing user value, and enhancing competitiveness.

IT makes smart PSS more convenient, and also makes users realize that the smart PSS not only provides user with basic functions, but also with experiences. Thus, [4] proposed that its presence and relevance for users is growing. They outlined seven characteristics of smart PSS in order to guide the design of smart PSS with UX. Further descriptions are provided as follows: (1) Consumer Empowerment: Consumers are enabled to make decisions following their own intentions. The digital service authorizes consumers to provide more targeted solutions to meet their own needs via self-help, and this authorization can enhance their sense of control. In addition, based on the feedback mechanism of IT, manufacturers can track their consumers' status, activities and preferences by using feedback data, and provide targeted service content to consumers [20]. It provides great convenience for access and selection of content. For example, Apple TV allows consumers to play any video without TV channel restrictions, and recommends videos according to user preferences. (2) Service Involvement: It is the level of interaction between manufacturers and users. In the past, the interaction only occurred in the physical space between manufacturers and users, but smart PSS can extend to the virtual space through online access, which encourages manufacturers and users to maintain an interactive relationship, and allows manufacturers to update functions with better content [20], for example, games, videos and books can be sold, accessed, and updated via online services. (3) Continuous Growth: It is maintaining user-perceived value through the evolution of product, service, and system. Despite novel smart PSS being able to attract consumers, novelty may diminish over time. Therefore, smart PSS can maintain the user activeness thorough updating of content to achieve competitiveness in the market. For example, the smartphone's application (app) provides regularly updated functions and appearance. (4) Individualization of Services: It is treating each consumer as a unique person, and providing customized content, in other words, users can obtain identity through being treated independently. Smart PSS supports communication between manufacturers and users, which occurs mostly in smart PSS virtual servicescapes [4]. Manufacturers record user data through marking each user's account, thereby offering a unique solution to satisfy user needs according to the user data, and gaining more consumption approval. For example, online shopping platforms (e.g., Amazon, eBay, and Taobao) will provide users with personalized recommendation interfaces according to the records and preferences from user accounts. (5) Community Feeling: It is a feeling of connection between users. An established community platform can effectively manage consumer opinions, allowing users to give each other feedback, and to share and exchange smart PSS information. It can promote rapid dissemination of word-of-mouth, and this kind of communication approach helps manufacturers get closer to users, and understand the real thoughts and needs of users [4]. For example, Uber provides a mechanism with scores and comments for customers from the perspective of the community. These reviews not only allow new users to quickly understand the business, but also help Uber to understand its disadvantages itself, thereby improving the interaction between businesses and customers. (6) Individual/Shared Experience: It is sharing mutual experiences to construct social relationships among users through the digital attribute of smart PSS, so that users have personalized experience with a high level of customization in smart PSS. Therefore, the sharing can link experience and services between users, and can stimulate users to understand, learn, and compete with each other [4]. For example, Pokémon GO created a virtual experience in the real world via an AR game, in which users share information about the game, and generate a competitive relationship during the game experience. (7) Product Ownership: It is the right of a product owner to define a product within a specified period of time. Product ownership is an eco-efficient feature of smart PSS, as the digital technology could effectively manage the lease and use of products, and provide support services for users [3]. For example, Philip's circular lighting program provides lighting services without product ownership, and manages the lighting devices via online services.

In summary, the smart PSS as a type of PSS still faces many

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challenges in practice due to the complexity of the context and perceived value involved. However, there is still a lack of relevant development experience of smart PSS [21]. Therefore, this research explored the innovation smart PSS strategy with UX, and addressed two major issues: (1) why Chunmi should develop the smart PSS strategy with UX; and (2) how Chunmi could successfully implement the strategic objectives of smart PSS through the design.
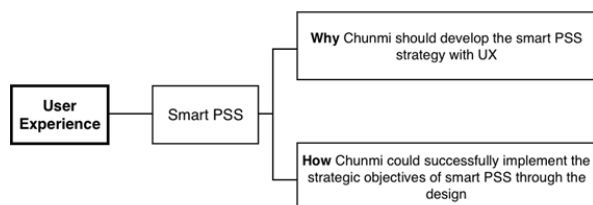

Fig. 1 Conceptual Research Framework

IV. A PARTICIPATORY CASE STUDY

A participatory case study is a type of case study that allows researchers to engage in all stages of the case, from the conceptualization to writing and dissemination of the research results [22]. In other words, a participatory case study is a research method that gives meaning to personal experience and behavior [24]. Participatory case studies are designed to solve specific local problems, and apply the results directly to current problems [22]. Thus, this study adopted the participatory case study approach to discuss Xiaomi's Chunmi, the largest IoT platform in the world, through the cooperation of academia and industry researchers. In addition, there are two reasons for choosing Chunmi as the focus of this study: (1) Chunmi, as a strategic brand for MI IoT's Smart Kitchen, is an internationally representative experience. (2) Chunmi is devoted to the development of the smart PSS from a design perspective, which is in accordance with the study purpose. In general, Chunmi has significant experience of the world, due to realizing the innovation of the smart PSS strategy with UX, and supports the user-centered design approach.

This research is based on the use of the Process-Based Methodology to understand the evolution of the smart PSS in different stages. First, the data collection for this study is discussed according to the early, middle and recent terms of the smart PSS in Chunmi. Secondly, the researchers reached a consensus at each stage by discussing issues during the data collection process. Third, the researchers repeatedly evaluated the skills and knowledge of partners to ensure consistency in the methods and opinions. Finally, this article summarizes the practices of the smart PSS with UX, and compares them with the characteristics of the smart PSS to explore the innovative aspects for the future.

V. A BRIEF INTRODUCTION OF CHUNMI INC.

Chunmi (Former name: Keladi) was founded in Shanghai, China in 2013. It provides IoT solutions for smart home applications. In 2014, Chunmi joined Xiaomi, and developed smart kitchen products and services with cost-performance for Xiaomi (Mijia). In 2019, Chunmi founded an independent brand for the high-end internet kitchen appliance market, to create an extreme cooking experience. The case of Chunmi is different from traditional manufacturers in two respects: (1) in terms of company attributes, Chunmi is different from product-oriented manufacturers, due to engaging in the kitchen market from the perspective of technology. Therefore, Chunmi has positioned itself as a service company in the beginning with digital technology; (2) in terms of its company strategy, Chunmi is different from market- and technology-oriented manufacturers, due to the designer participating in the company's decision-making. Therefore, Chunmi could go through the hardware, software, and content by design thinking to make systematic decisions from the user's perspective.

Since its establishment, Chunmi has continuously evolved and expanded. Therefore, the development of the smart PSS could be divided into three stages according to different product positioning, service content and system support. This development is further explored through the Process-Based Methodology.

VI. DEVELOPMENT OF SMART PSS WITH UX

"Innovation" plays a key role in competition, leading to the increasingly important strategy of distinguishing competitors in the market [18]. Accordingly, Chunmi had two reasons to develop the smart PSS strategy with UX: (1) The Chinese kitchen appliance industry is a highly competitive market. The traditional manufacturers have numerous resource advantages. As a start-up company, Chunmi tended to be weak in terms of manufacturing, so it had to distinguish itself from traditional manufacturers through smart PSS strategy with UX. (2) The Chinese manufacturers are actively conducting digital transformation due to the promotion of "Made in China 2025." Therefore, Chunmi found that digitalization will no longer be the trend of competition in the future, but rather how to make technology more adaptable to face the quickly changing needs of consumers. In summary, this section further explains the advantages of the smart PSS strategy with UX from three aspects in terms of product, service, and system.

A. The Product Aspect

Traditional manufacturers develop products via the technology-centered approach [8], but Chunmi found that IT was imposed on the functions that only realized electronic control in physical conditions, but without really connecting people with the product. Therefore, Chunmi understands two terms from the user lifestyle and behavior by UX: (1) In terms of shape, traditional products pay a great deal of attention to the decoration of the appearance, rather than to the shape itself, leading to inefficiency and inconvenience in the using stage; (2) In terms of operation, many manufacturers use new technologies to improve the operation in the using stages, but new technologies often fail in the real environment due to physical interference. For example, the virtual touch technology makes kitchen products novel, but oil and water in the real environment could cause the touch function to fail.

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Smart PSS		Early-term (2013-2014)	Mid-term (2014-2019)	Recent-term (2019-present)
Componets	Series	Keladi	Mijia	Tokit
Product	Rice Cooker	AC-bird rice cooker	Mijia rice cooker 4L	N. A
		N. A	Mijia rice cooker mini	Tokit rice cooker mini
		N. A	Mijia rice cooker C1	N. A
		N. A	Mijia HI rice cooker (3L &4L)	Tokit HI rice cooker
		N. A	Mijia pressure HI rice cooker	N. A
		N. A	Mijia pressure HI rice cooker 1S	Tokit pressure HI rice cooker
	Induction Cooktop	N. A	Mijia Induction cooktop	Tokit Induction cooktop
		N. A	Mijia Induction cooktop for young	Tokit Induction cooktop for young
		N. A	Mijia Induction cooktop A1	N. A
		N. A	Mijia Induction cooktop C1	N. A
	Pressure Cooker	N. A	Mijia Pressure cooker	Tokit Pressure cooker
	Oven	N. A	Mijia oven	Tokit oven
		N. A	N. A	Tokit oven mini
	Microwave	N. A	Mijia Microwave	N. A
Service	Operation	Cloud delicious app	Mijia app	Tokit app
	Content	N. A	ZHU app	ZHU app
	Community	N. A	Mi community	OCOOKER
System		N. A	Keladi	Mijia	Mijia & Tokit

Fig. 2 Chunmi's Smart PSS

B. The Service Aspect

Traditional manufacturers are accustomed to product-dominant logic, and they are impatient with the long cycle and high cost of service development. They believe that developing services with UX is only additional performance [18]. Based on this, Chunmi believes that real smart products must depend on services with UX. Therefore, Chunmi's management thinks that the product and service are equal parts of the development to improve the attractiveness of the product. For example, Chunmi analyzes user food and taste preferences from user data, translates them into a corresponding recipe service which it delivers it to the users.

C. The Systems Aspect

The traditional manufacturers are always focused on a specific demand, but user needs are not singular. For example, cooking involves a whole meal rather than a single dish. In contrast, the existing smart products and services are relatively fragmented in their use process, with different products corresponding to different service interfaces which cannot work together. Therefore, Chunmi thought of developing a support system with UX to create a comprehensive cooking experience. For example, Chunmi found that younger users are not only bad at cooking, but also do not prepare ingredients, so Chunmi integrated the material channel into the system to provide users with the service of selling.

VII. IMPLEMENTATION OF SMART PSS WITH UX

Chunmi was initially an IoT company. It encountered many difficulties in the manufacturing stage since entering the kitchen appliance market. Therefore, the founder invited Japanese experts to join the team, and developed products and services through cooperation with a designer from Xiaomi. However, it spent a great deal due to inefficient communication with external designers. Thus, Chunmi invited a designer to join the decision group to integrate products and services by design in 2016.

Chunmi's design-led thinking was that the UX design could make the product and service meaningful, and could thus realize smart PSS innovation. Therefore, Chunmi understands the demand from user behaviors and lifestyles, then translates them into the development of products and services through UX from the user perspective to improve their experience. Based on the Process-Based Methodology, this section further discusses the three stages of the development of Chunmi.

A. Early-Term Birth (2013-2014)

The IoT industry started in China in around 2012, and led to incoherent industrial structure and high costs. The physical electronic control could not represent the full advantages of IoT, and it had limitations in providing services to the high-end market due to high prices. Therefore, Chunmi's founders believe that the role of service provider lacks influence on product development, and limits user participation in both product and service. Only by leading the product development and improving the experience could the smart kitchen become a reality. This also confirms once again that the SCPs are a key point of smart PSS [20]. Thus, Chunmi started a smart kitchen appliance project "AC-bird" in May 2014. It is a smart rice

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cooker product which the users not only remotely control and record using their mobile phones, but which also guides the process of cooking from the digital recipe app. This user-oriented development strategy received widespread attention on China's crowdfunding platform, and got a chance to join the Xiaomi Ecological Chain.

B. Mid-Term Exploration (2014-2019)

Despite the "AC-bird" project solving the demand for cooking assistance, cooking is not a linear behavior in life due to the users needing a variety of products and services during the cooking process. Therefore, user needs could only be satisfied by connecting a single product with other products. Thus, Chunmi's thinking was that the smart kitchen should integrate different products and services from the perspective of user needs. (1) First, Chunmi positioned the product category in kitchen appliances according to its manufacturing capability and quickly expanded its product line according to the different demands of user groups. However, the extension means increased costs and uncertainty, and so they provided different versions (e.g., price, size, and color) for risk reduction. For example, Chunmi provides a low-cost version of the induction cooker with basic functions for younger users. (2) Secondly, Chunmi has established a service content platform—the "ZHU" app from which users can obtain or share different recipes and purchase related cooking implements from the platform. (3) Chunmi has continuously improved and updated its products and services according to the user data from the Mijia system, to maintain high satisfaction. For example, Chunmi founded a service for selling ingredients, but it is difficult to find the corresponding digital recipe from user feedback, so Chunmi printed the QR code for guidance on the packaging.

C. Recent-Term Growth (2019-Present)

Although Chunmi quickly integrated the different products and services into the system, due to the large number of products and services, the majority of users are paying increasing attention to the cooking experience. However, this approach is contrary to the cost-effective strategy of Xiaomi, which has led to many design concepts not being able to be implemented. Therefore, Chunmi believes that the overall brand of the company should be managed by UX.

Chunmi published a high-end smart kitchen brand—Tokit, in March 2019. It focuses on how to provide a pleasurable cooking experience. In order to realize a high-quality experience, there are three features of this brand: (1) Product series: Tokit was only re-designed for four successful product series (e.g., rice cooker, induction cooktop, pressure cooker, and oven). (2) Service customization: Tokit service not only relies on Mijia, but also develops private services for Tokit only, thus providing services according to the user's preferences or situation. The content is presented visually to ensure that the user can have a pleasant experience. For example, the Tokit app will recommend digital recipes to match the user's behavior or lifestyle, and presents digital recipes from pictures to videos. (3) Community operation: Tokit established an independent community service separate from Mijia, and re-constructed social relationships in a closed group for deep-users only. In addition, in order to integrate online to offline activities, Chunmi has founded a new business model—MiZhiChu, which allows users to enjoy Chunmi's products in restaurants by themselves, allowing the company to explore potential users in an offline restaurant.

VIII. RESULTS & DISCUSSION

Chunmi's innovative smart PSS strategy is due to the UX design. Therefore, we list the smart PSS strategy with UX in three stages of Chunmi, through the characteristics of smart PSS (such as Table I) in this section.

A. Early-Term: Integrated Products and Services

As mentioned before, most manufacturers take technology as the main goal of PSS innovation, but we found that the development of smart PSS should focus on improving the experience of technology in the case of Chunmi.

In the early-term, improving the feeling of control is one of the most significant advantages of smart services [4]; it empowers users to choose services by themselves. Chunmi soon realized the advantages of digital services in consumer empowerment, due to initially being an IoT company. On the other hand, it encourages user participation in service for increased service involvement, due to independently developing SCPs to integrate online and offline services. In addition, the updating of content and user data ensures Chunmi's continuous growth.

B. Mid-Term: Constructing Holistic Service

Smart technology often improves a single aspect of feeling, but tends to ignore user demands in the using stages [8]. We have found that smart PSS should be based on the user needs from the case of Chunmi.

The preferences of users and providers may differ, so the development must consider the needs of both sides [18]. In doing so, manufacturers could assess their own development capabilities from the perspective of users. In this case, Chunmi positioned itself in smart kitchen appliances based on its own capabilities, not only empowering consumers through digital service, but also rapidly expanding its product line (a total of 14 products were developed in the mid-term) to increase the touch point of services for service involvement. In order to expand, Chunmi developed multiple versions of products to provide personalized options for different users, thus ensuring both the individualization of services and continuous growth. In addition, smart PSS has the ability to connect, collect, and analyze data [23], which gives users a positive feeling from exchanging and sharing on the community platform.

C. Recent-Term: Creating High Quality Experience

Smart PSS can create a meaningful experience for users [4], which is confirmed by the experience of Chunmi. The user needs are not the result of smart PSS only, but the experience of the entire process.

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TABLE I
THE CHARACTERISTICS OF CHUNMI'S SMART PSS

Characteristics of smart PSS	Early-term	Mid-term	Recent-term
Consumer Empowerment	Enhancing user feeling of control through the user choosing digital services by him/herself.		Providing a feedback mechanism to allow users to set goals according to their own situation, and gaining a sense of achievement from it
Service Involvement	Integrating online and offline services, and increasing opportunities for interaction with users by developing SCP independently.	Expanding the product line to give users more options of engagement.	Making users participate in value creation and gaining pleasure from the process and result.
Continuous Growth	Continuously updating content to increase user interest	Developing different versions of products (e.g., size, price) to satisfy the different user groups.	Segmenting the brand to correspond to the evolution of user needs.
Individualization of Services	N. A	Providing different prices, functions and types of service options for different users.	Customizing the setting of product and service according to user preference.
Community Feeling	N. A	Relying on the IoT platform to provide services with feedback, sharing, and exchange of information from which users gain a sense of belonging.	Establishing a closed user communication platform to accurately respond to needs, and gaining pleasure from communicating with each other.
Individual/Shared Experience	N. A	Providing users with a channel to share experience and content, which increases the existing feeling of users.	To gain user achievability from making the personal experience become a part of the content through highly customized functions.
Product Ownership	N. A	N. A	Establishing offline stores to replace purchases with experiences, and attracting potential users.

In the company's overall brand management process, the brand image should be consistent with UX [14]. Tokit is a high-end brand which focuses on meaningful and pleasurable cooking experiences. Tokit makes meaning for products and services through user participation in the process of value creation, and links the meaning and experience with pleasure. For example, Tokit allows users to define the functions option (e.g., function name, function combination, and function setting) to fit each situation and emotion by customization. On the other hand, the customizable service innovation benefits from consumer empowerment and service involvement [21]. In this case, Tokit depends on the independent user platform to construct user relationships with pleasure by sharing and communication. In addition, product ownership is the characteristic of smart PSS which only appeared in the recent-term of Chunmi. Chunmi uses part-time experience instead of full-ownership purchasing through establishing offline experience stores. This strategy was proposed to break the growth limitation of the business, because the acceptance of high-priced smart products and services still needs to be tested by the market. In this way, product ownership could reduce the cost of unit-use to get rid of cost limitation, and explore potential users.

IX. DIMENSIONS OF UX DESIGN FOR SMART PSS OF CHUNMI

As mentioned before, smart PSS has received widespread attention as an emerging field. Based on the opinions of scholars in the field of smart PSS and UX [2], [4], [16], [[17], [19], this study summarizes the three dimensions (interaction, expectation, and enjoyment) to evaluate UX design for smart PSS innovation, with further descriptions below.

First, interaction is the process of connection between different things. The experience of interaction originated from the psychological needs during the using stages (e.g., safety, excitation, and satisfaction) [17]. Pei et al. [20] proposed that

SCP is a medium and tool which enables active interaction between manufacturers and users, then promotes the development of new services. It conformed to involving users in the service in the early-term of Chunmi. In addition, we found that interaction is also one of the reasons for service innovation in Chunmi, such as a food sale service linked to cooking. Therefore, it is considered that interaction can be used to evaluate UX design for smart PSS innovation in the future. Secondly, expectation is the idealized demand of services for users. Parasuraman et al. [2] proposed that understanding user expectations is critical for experience, and an important way to increase competitiveness in the market. Smart PSS is a digital service strategy, which has some advantages in identifying user behavior and potential needs [10]-[20]. In this case, Chunmi has greatly improved user satisfaction through understanding what users really need, and putting it into development. Therefore, it is considered that expectation can be one of the dimensions to evaluate a good UX design for smart PSS. Thirdly, enjoyment is a kind of positive experience or feeling. A good UX design could provide users with a positive emotional experience in terms of usability, aesthetics, and hedonism [16]. Co-creation gives special meaning to products and services, calling for positive feelings through user participation in the development of smart PSS [4], [21]. In this case, Chunmi treats smart PSS as an entire experience, allowing users to get emotionally set to enhance the experience through customization during the using stages. Therefore, it is considered that enjoyment is one of the dimensions of evaluation for smart PSS innovation with UX.

X. CONCLUSION

In the time of the IoT, more attention is paid to UX design in smart PSS due to the user-centered development of products and services having many achievements. In order to clarify the contribution of the smart PSS strategy with UX, this research

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collected relevant data about Chunmi through a Participatory Case Study with the Process-Based Methodology, to discuss smart PSS further and fill the research gap in the smart kitchen appliance market. The specific conclusions are as follows: (1) UX could increase user value with differentiated products and services, but UX development requires a great deal of time and a variety of methods. Therefore, smart PSS can distinguish competitors by their unique UX that is difficult to duplicate; (2) UX originates from cognitive impressions and reactions at all stages of use, so allowing users to participate in the development of products and services could help designers understand their needs. Therefore, early user engagement is crucial for the success of smart PSS; (3) interaction, expectation, and enjoyment can be treated as a three-dimensional evaluation of UX design for smart PSS innovation. In conclusion, smart PSS can gain competitive advantages through good UX design in the market.

Although Chunmi has realized smart PSS innovation with UX, there is still a gap between product/service design and value delivery, such as the conflict between the development costs and user affordable prices of high-end products. This also forced Chunmi to try to develop several non-smart products for Mijia last year (e.g., Mijia Microwave, Mijia oven, and Mijia induction cooktop C1). In addition, the authors found this gap from observations and interviews which indicated that some users have difficulty using and are resistant to smart technology (e.g., the elderly or the disabled), which has weakened the growth of the smart PSS. Therefore, we can start with the user acceptance and perceived value of smart PSS in future research, then understand how to better deliver the value of smart PSS which can help designers make better decisions in its development.

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