RESEARCH AND TEACHING PRACTICE OF PRODUCT SERVICE SYSTEM APPLIED TO DISTRIBUTED ECONOMY

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ABSTRACT

In order to promote sustainable development and build ecological civilization, This paper firstly conducts a comprehensive study on the respective attributes and correlations of product service systems(PSS) and distributed economy(DE) which based on a large number of literature reviews and case studies, including method exploration, theoretical induction, practical applications and elements. Under the guidance of extracting the keywords and their potential relationships, then using the quantitative application of class III and cluster analysis methods to analyze the application status, organizational forms and method theory of the product service system applied to the distributed economy to explore more research gaps and potential development space. Secondly, the paper examines how to use the product service system to the distributed economy in the Chinese context by combining LeNSin's international network teaching practice in China with the practical design propositions, and design works cases, which based on seminars pilot courses, teaching practice, and student activities.

Keywords: Sustainable development,Distributed economy, Product service system design

1. INTRODUCTION

In September 2015, the United Nations Development Summit adopted the 2030 Agenda for Sustainable Development, which covers 169 sustainable development indicators in 17 major areas, and the globally sustainable development path from the economic, Social and environment dimensions(Pan jia hua et al,2016). At present, in the field of design with sustainability, domestic and foreign research have gradually expanded from product design such as green design, reduced design and full life cycle design to system level such as product service system design, social innovation design and transformation design(Xin Xiang-yan,2016).

2. LITERATURE REVIEW

A literature review was carried out to identify the primary classification of the distributed economy(DE) and the structure of product service system(PSS), and to summarise existing organizational model to apply DE to PSS development.

The concept of a distributed economy first appeared in the early 20th century. Johansson and Mirata define it as small-scale regional production units that are synergistically linked to each other and use local resources(Baranp,2009). VDD Annemieke proposed that the distributed economy is a more sustainable social and economic development model, with the ability to make full use of the production of small-scale enterprises in the local economic context(VDD Annemieke et al.,2009). The LeNSin International Sustainable Design Network project under the guidance of the European Union in 2016 defines the distributed economy as a local-based small-scale supply model. The result is a structured network collaboration. The distributed economy can be summarized as a decentralized production and consumption, transportation, operation, and marketing model organized in small, scattered and flexible units. it forms a local network and interconnects with similar systems in the vicinity to build a more extensive collaboration and co-creation network.

The distributed economic model advocates the design process of region-based customization activities and user participation,which is highly compatible with the product service system design. Therefore, the introduction of the concept of the product-service system into the development of the distributed economy has certain possibilities and development potential.

The distributed economy is not a new type of model that conflicts with large-scale centralized production methods. In traditional society, the small-scale peasant economy woven by women and men has already had distributed characteristics, but the development of information society has spawned more forms. From the perspective of resource classification, it can divide into Distributed Renewable Energy (DRE), Distributed Manufacturing (DM), Distributed Production of Information (DI), and Distributed Design (Distributed).The Distributed Production of Design(DD), and Distributed Labor (DL).

The driving force behind the development of distributed renewable energy (DRE) lies in the improvement of new energy acquisition technologies that gradually become individualized, low-cost, and democratized, such as home solar power systems or home wall-mounted gas heating systems (Emili S et al.,2016).The technology driving force of distributed manufacturing (DM) lies in the development of small-scale additive manufacturing technologies such as 3D printing. Like some small open community manufacturing workshops equipped with tools such as 3D printers, stereolithography, and selective laser sintering. Production units of the same character are composed of local collaborative manufacturing networks such as FabLab, Makespace, MakerNet and other laboratories (Cindy Kohtala, 2015).The distributed information (DI) network is the primary source of fragmentation, personalized information and services for consumers in the mobile Internet era. It is also related to user-created content, such as early Weibo, Facebook, and WeChat that produced with the patterns of Internet information.Distributed Design (DD) based on artificial intelligence-assisted, large-scale collaboration and participatory open design projects to achieve the goal that everyone can design, such as providing electronic banner generation services based on big data algorithms. Or the Internet and crowdsourcing models based design tasks such as Pig Eight Rings, Luo Ke.According to the trend of China's existing Internet development, the author proposes the concept of distributed human resources (DL), which emphasizes the role of personal resource power in the context of informationization, such as micro-business, self-media operation, etc. The driving force for its development lies in the construction of a networked personal resource pooling platform, and the centralized organization of human resources to play its role in the creation of a knowledge economy.The distributed economy has penetrated various economic fields such as energy supply, upgrading of manufacturing industry chain, the Internet economy, and sharing of surplus resources. It has become an emerging force that promotes supply-side reform and transformation, transforming old and new kinetic energy, and solving fragmented economic surplus. At the same time, with the support of policies, it is expected to promote the development of social innovation such as mass entrepreneurship, poverty alleviation and lifestyle change.

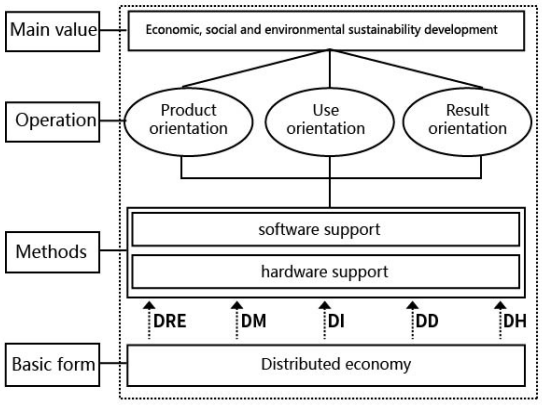
3. THE PSS APPLIED TO THE DISTRIBTTED ECONOMY

The concept of Product-Service System (PSS) was first proposed by the United Nations Environment Program in 1994, from the simple design and sales of "materialized products" to the provision of a comprehensive "product and service system" model to meet the unique needs of people. Manzini believes that Product Service Systems (PSS) is

an innovative strategy that shifts the economic model from focusing only on the production and sale of physical products to concentrate on the integration of products and services that meet customer needs (Manzini et al.,2001). Tischner U and Verkuijl proposed three major classifications that are widely recognized by the academic community: a product-oriented, usage-oriented and results-oriented product service system(Tischner U and Verkuijl,2006).

3.1Organizational model

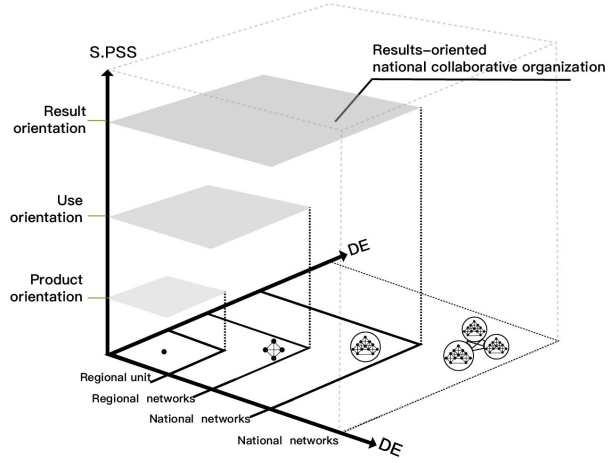
The product service system applied to the distributed economy can systematically think and plan information, funds, services, and materials in the region, and provide a variety of dimensionally oriented products and services to reduce costs and waste of resources(Fig1). The distributed economy of various forms is the underlying economic organization structure, such as 3D printing technology, laser cutting, cloud services, big data, natural language understanding, and other manufacturing technologies and artificial intelligence, which provides technical support and platform support to the operation of the service system. On this basis, we will gradually develop product-oriented, user-oriented, results-oriented products and services to meet the needs of users, effectively reducing energy consumption and commodity abandonment rate to achieve sustainable development goals.



[Figure 1] Organizational model of the product service system for a distributed economy

3.2 Collaborative network

According to the organizational scale of distributed production units, it divided into regional production units, local networks, national collaborative networks, and global collaborative networks. According to the classification of the product service system, it is divided into three levels: product orientation, use orientation and result orientation. Like a regional production unit, a small family-based power generation organization can purchase solar panels by itself and obtain related maintenance and after-sales services. This is a typical product-oriented product service. And if you get the energy you need by renting a solar panel, it becomes a use-oriented product service. you can also pay for the lighting function that meets the daily needs, without renting or buying. It is a result-oriented product service system. As we can see, In a distributed model, a large number of regional production units are interconnected to form a larger collaborative network in Fig2



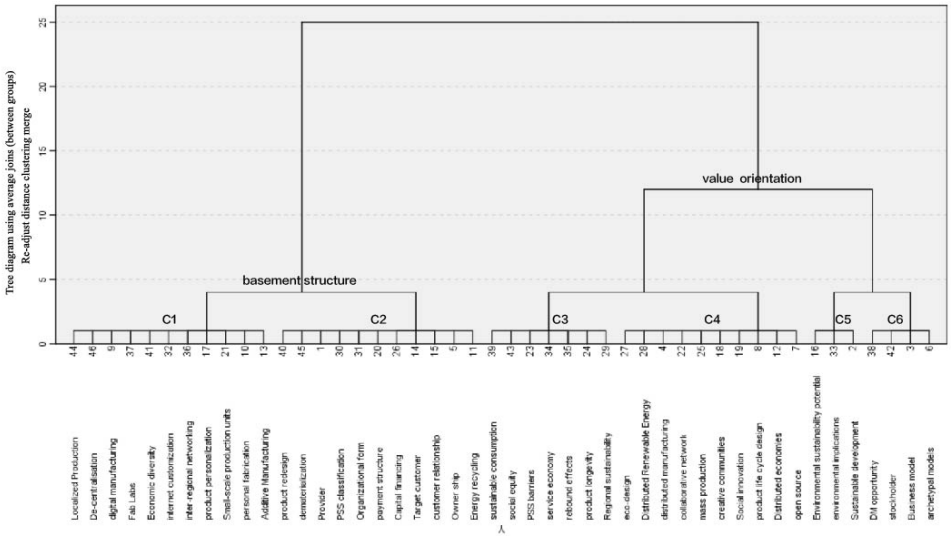
[Figure 2] Hierarchical Analysis of Product Service System Applied to Distributed Economy

3.3 Research focus and development trend

This article uses Python to crawl 15 important product service systems and distributed economic related research literature and calculate the word frequency distribution of keywords and represent these 46 keywords. The spatial

point is visualized to obtain a distribution map of keywords. Based on cluster analysis, 46 keywords divided into six groups of C1-C6(Fig 3).

C1 mainly studies the application of the product service system to the distributed economy from the perspective of the logical relationship between elements. The analysis shows the crucial components in this process: open source, payment structure, ownership, target customer, service provider, which are the fundamental guarantee for the operation of services. C2 mainly analyzes different scales and service scales from the perspective of organizational method management, such as regional network, personal customization, de-neutralization, economic diversity, localized production, etc., showing various forms of organization of the distributed economy. C3 mainly summarizes the value orientation of product service systems applied to distributed economy from the perspective of value proposition, such as extending product life, regional sustainable development, sustainable consumption, service economy, social equality, rebound effect and so on. C4 mainly discusses the research of basic service paradigm, which involves five primary forms of distributed economy, distributed energy, distributed design, distributed manufacturing, spread information, distributed software, etc, and also from the social level. Including social innovation, green design, product life cycle design. C5 is a breakdown of the factors influencing participants, focusing on the many obstacles and opportunities in the application process, such as the obstacles of PSS, the chances of DM, the limitation of business models, and the distinction of stakeholders. C6 emphasizes the application of product service systems to the assessment of sustainable potential in a distributed economy, such as sustainable development, environmental impact, and ecological sustainability.



[Figure 3] keywords analysis

3.4 Result

The current research mainly focuses on the logical relationship between organizational forms and elements, and refines the corporate scale and distribution of human and material resources of the product service system in a distributed environment. In the two areas of distributed energy(Silvia Emili et al.,2016) and distributed manufacturing(Petrulaityte A et al., 2017), we have achieved phased results. The author believes that the next phase of research focuses on how to improve service quality, service efficiency and coordination of the factors affecting participants. The methods and tools in the fields of management, engineering, and psychology can be learned.

4. CASE PRACTICE

4.1 background

The project depended on the LeNSin project with the European Union. The team of research comes from Hunan University and Tsinghua University. The project organized with the theme of “the sustainable of the human local food network” in conjunction with the Hunan Agricultural Internet brand “Huinong.com” in January 2018. From the perspectives of localized food and regional cultural heritage, sustainable agriculture.

4.2 Needs analysis

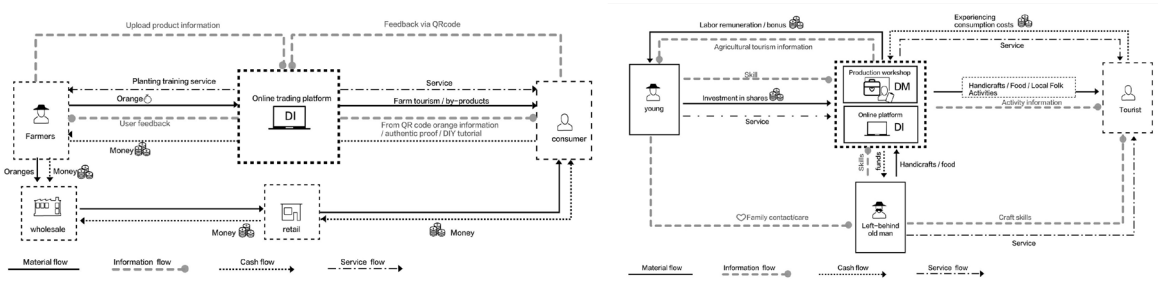
According to the survey, Chinese agricultural development still has problems such as the low degree of organization, relatively primitive and experienced production technology, severe shortage of infrastructure, and imperfect social service system(Xiang Ning,2018). It fully reflects the current industrial chain from agricultural has the features of distributed.

Therefore,In the early days, design tools was used to design from three dimensions: cultural inheritance, bottom-level people design, and agricultural production. The project has unearthed more than 20 demand points such as agrarian product cultivation training, agricultural product warehousing logistics, regional representative agricultural product promotion, left-behind elderly childrende so on.

4.3 System design

In the system design stage, with the help of design tools, it produces 14 design orientation based on distributed manufacturing (DM) and Information (DI) localized agricultural solutions. For example, in the design of community production service system based on distributed manufacturing (DM) for cultural inheritance and vulnerable groups, the needs of the left-behind elderly in the local community are included in the system thinking, through the establishment of an online service platform that displays information and skills sharing for the elderly. The sale of food and handicrafts hand-made by left-behind people is used to enhance and promote their sense of value and physical and mental health. At the same time, such distributed production workshops help young people in ethnic minority areas in Hunan Miao to make full use of local natural resources and cultural resources to promote local agricultural development and agricultural tourism activities. It not only meets the needs of tourists returning to nature, but also achieves the goal of reducing the number of young people going out to develop characteristic tourism in poverty-stricken areas, and promoting local poverty alleviation(Fig 4).

In term of designing a distributed information (DI) product service system for the distribution of specialty fruit and vegetable industries in Hunan Province, through the establishment of an online platform to open up information barriers between farmers and consumers, making enterprises, consumers, Multi-stakeholders such as farmers, governments and NGOs are considered in a system framework. Guided by consumption to avoid overproduction of food, and realize dynamic monitoring of production processes from production, processing, logistics, wholesale and retail to consumption. For the problem of local orange output, the online trading platform provides farmers with market information and agricultural planting knowledge. Farmers sell unsalable oranges to the platform and get a certain amount of compensation. Farmers sell oranges to consumers through distributed information online network platform. Consumers can understand the production process of oranges and DIY processing methods by scanning the two-dimensional code on the fruits, and conduct the online evaluation. The online platform collects these evaluations and feeds them back to the farmers to guide the production activities.



[Figure4] The example of case practice

5. CONCLUSION

By combing the relevant theories of distributed economy and product service system, this paper clarifies the organizational form, stratification strategy and design method of product service system applied to the distributed economy, and combines EU LeNSin project with Hunan local food network. It hoped that the sustainable product-service system (S.PSS) would be used to develop the potential of new economic and social forms, creating opportunities for promoting sustainable business models and innovative industries. At the same time, new tools and design methods will need to incorporate into this process. Helping the system continuously meets the requirements of economic, environmental and socially sustainable development.

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