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Fresh Flower Product-Service Systems Designed with TRIZ-Based Method

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Abstract

In product service systems (PSS) design and with sustainable development needs, conflicts usually emerge due to a major reason of requiring high-lever component functions, which could simultaneously add complexity to a system. However, there is no research found that provides a well-structured methodology for eliminating identified contradictions in PSS design. To narrow this gap, this study proposes a systematic PSS design approach based on the TRIZ methodology for generating systematic solutions. A research-based design case enacted the proposed method to show its feasibility. In this context, a design team was formed for the PPS system design regarding online/offline shopping service systems with fresh flower products based on marketing needs, such as customers, the flower industry, and the e-commerce environment. The results demonstrated that the proposed approach is feasible and effective in innovation service, with the case study, while aiding the design team in creating PSS products and services. The identified contradictions were tackled in the design process, which generated intensive resolutions for the PPS systems. Finally, the study discussed the features of the PSS design compared with the previous study regarding another PSS model of sharing bikes, and summarized the facilitations with various techniques, e.g., a service blueprint for the online/offline shopping journey.

Keywords

Fresh Flower Products, Online Shopping, Product-Service Systems, Service Design, TRIZ.

Introduction

Since customer needs became increasingly diversified and tended not to only require ownership of physical products, under this circumstance, there has been an increasing trend in which companies shift their business strategies from designing, developing, and manufacturing products to selling, delivering, and innovating services (Kim & Yoon, 2012). The change caused them to maintain growth by integrating services into their products, although such companies had originally made profits by only providing products to customers. These attempts can be regarded as product service systems (PSS), and the concept is first recognized as a set of products and services that fulfill customer needs and have lower environmental impacts (Goedkoop et al., 1999). Nowadays, PSS design is regarded as an integrated system of products and services for stakeholders, and it can be considered a novel concept for companies to improve their innovation strategy from developing physical products to innovating a system of products and services (Manzini & Vezzoli, 2002). Furthermore, it involves the integration of both tangible and intangible interfaces with systems and processes (Chang et al., 2023; Chou, 2021). The design of PSS can offer customers service experiences while also contributing to sustainability by potentially reducing the environmental impacts of both production and consumption. Particularly, PPS design supports a market proposition that considers value co-creation and expands a product's functionality by unifying additional services for customers and other stakeholders, further building positive customer relationships between companies (Beuren et al., 2013; Kuijken et al., 2017). The previous study pointed out that PSS design methodologies can be classified into 6 types: the customer perspective, modeling techniques, visualization methods, modularity, TRIZ, and system dynamics (Qu et al., 2016).

In the development of PPS systems, conflicts usually emerge due to the major reason requiring increased usability or serviceability from function components, which could simultaneously add complexity to the systems. However, there is less research that provides a well-structured methodology for eliminating identified contradictions in designing an innovation service. The Inventive Problem Solving (TRIZ) methodology is integrated as an effective approach for resolving contradiction problems to enhance innovation service system design (Zhang et al., 2003; 2003). This study proposes a systematic PSS design approach based on the TRIZ methodology for generating systematic service concepts. In a design-based case implement the proposed method to show its feasibility. In this context, we formed a design team with a design project, that wanted to build an online/offline shopping service system with Fresh Flower product service for customers and other stakeholders. Moreover, we pursued building user-product interaction through interactive, digital technical, and sustainable service systems, for which we initiated a PPS design with the TRIZ method from the proposals based on local marketing research. The design study is project-based, beginning with the marketing needs. First, it considers specific customers experiencing work-related stress in the region. Therefore, Fresh Flower product service as a resolution can be utilized to improve office environments to help officers alleviate stress to a certain degree around their work (Dijkstra et al., 2008; Deng & Deng, 2018; Meng et al., 2022). The second comes from the flower industry in the Dounan Flower Market, which is a renowned wholesale flower market in China (Huan & Dong, 2014; Sun, 2024). The third comes from the flower e-commerce/electronic commerce environment for online/offline shopping, which includes platforms such as live streaming and online shopping (Ye, 2022).

In general, this study provides a systematic way to construct a Fresh Flower Retail Delivery Service System concept (also abbreviated FFRDSS), in which we developed the PPS design based on the proposed TRIZ method. Thus, the proposed method was demonstrated in the design case that developed online and offline shopping systems and presented the innovative service concept generations since the Flower Product Service System has been seen as one of the most widely used tools in our daily work of e-commerce in the local area (Ye, 2022). Finally, discuss the effectiveness of the method to approach innovative services, and the features of the FFRDSS PSS systems compared with our previous study (Yang, 2024) regarding another PSS model of sharing-bikes. And summarized the facilitation with various techniques, e.g., using service blueprints for online/offline shopping journeys.

Theoretical Framework

Product Service Systems (PSS) present a novel selling concept that integrates tangible products and immaterial services to fulfill customer needs (Oliva & Kallenberg, 2003). PSS has three components, including products, services, and software (Carpanen et al., 2016). Thus, the PSS components lead to extended complexity during PSS development because they require the integration of diverse information associated with different domains of professional knowledge. Several studies suggest that PSS in the manufacturing industry can occur in three main categories: *product-oriented* PSS, *use-oriented* PSS, and *result-oriented* PSS (Kim & Yoon, 2012; Resta et al., 2015). Product-oriented PSS involves providing services through post-sales activities, such as technical support and maintenance services. Use-oriented PSS refers to a way of paying by use to combine a set of products and services that are offered, such as sharing-bikes service. Result-oriented PSS involves providing integrated solutions to customers from ideation to implementation. However, the PSS design challenges complex service problems compounded by the ill-structured nature of design problems, where often one or more states are either unknown or incoherent, and these are referred to as dealing with wicked problems (Buchanan, 1992). The design for PSS, therefore, requires a systematic approach to couple with the relevant components simultaneously. They are complex artifacts composed of products, services, business models, and a network of stakeholders who produce, deliver, and manage PSS (Mont, 2002). Many innovative and qualitative methodologies are being used in service design, and the focus has shifted from tangible products to intangible services. For example, the TRIZ method can be applied to effective service design. Based on customer needs, we applied the Quality Function Deployment (QFD) method to innovation services to generate the design needs and process the service requirements (Tukker & Tischner, 2006). A service blueprint is the main tool based on visual design to transfer abstract, interactive service activities to clear descriptions (Bitner et al., 2008).

Al′tshuller (2000), the TRIZ method of the proponent, found that the same problems were often solved repeatedly using only 40 fundamental inventive principles. In the TRIZ methodology, the fundamental idea in the conceptual framework is the extraction of the essential conflicts from the problems and eventual resolution. Al′tshuller asserted that an invention frequently appears when a contradiction between the engineering parameters is recognized and resolved. The contradictions can be seen as either technical contradictions or physical contradictions, that is, technical contradictions can manifest as two mutually conflicting parameters within a system, or physical contradictions can be the direct opposite of two values for a parameter formulated by the same system. Regarding resolving contradictory problems within a system, for inventive solutions, the contradiction matrix is the most popular TRIZ tool, comprising 39 engineering parameters and 40 types of inventive principles. The 39 engineering parameters are defined as the behavior or state of a technological system, and most of the engineering objects are a compromise between competing features, i.e., corresponding parameters; in other words, if you try to improve one feature, it often degrades another. Specifically, these 39 features are arranged on each side of a two-dimensional matrix, and at each intersection, some inventive principles are addressed and indicated as innovative solutions for reference use. Currently, designers use the summarized 40 inventive principles as generic suggestions when performing design actions on and within a technical system, which correspond to the contradiction matrix.

Conventionally, technical fields have used TRIZ as a knowledge-based tool for problem-solving. However, due to its modified inventive principles, non-technical areas can apply a variety of modified and extended tools for service design (Zhang et al., 2003; 2003). Concerning the TRIZ methodology, the 40 inventive principles present complete descriptions of the detailed solution thinking contained in each principle, and then the principles can be used to resolve a given situation corresponding to contradictions. Addressing contradiction issues in PSS design, some previous studies involved how use TRIZ method with the toolset to dealing with contradictory situations in the field (Shahin & Pourhamidi, 2011; Jiang et al., 2010; Chai et al., 2005). In previous study (Yang, 2024) described the PSS design has received noticed more because it has the characteristics of environmental protection, social and economic effects. Regarding the case of bike-sharing services, the service providers help users obtain services in a leasing way. Users only use mobile app-based services to operate the operations and then get the bike with the related riding services. Through the use of the bike-sharing PSS system, the design purpose of a potential transition emerged and engaged in low-carbon mobility in urban areas is successful achieved.

Methodology

The design team conducted the research for the PPS design projects at the School of Communication and Design Art, Yunnan University of Finance and Economics, China. Seven product designers participated in collaboration. I was responsible for the research-based design with the team. The design process comprised two phases: the conducted marketing research and the concept design, which began with the input from the marketing research results. The research concerned exploring the needs and preferences of various user types. Typically, user-centered design (Abras et al., 2004) conducted survey processes with questionnaires, interviews (Wilkinson & De Angeli, 2014), and site observations. The market survey collected the data, and the analysis process generated the research results.

In the design task, the designers were required to approach the proposed method to develop a novel service system concept, namely the FFRDSS system, in which the smart parcel delivery lockers were designed to facilitate the resolution of the systematic services for dealing with physical products. The PSS design addressed the problem of work-related stress among office workers. According to the research results, we recognized that work-related stress, e.g., anxiety, negatively exists in office workers because workloads arise. (Dijkstra et al., 2008). Through the concept design intended to improve the office environment to help office workers relieve stress to some degree at work, this design project was grounded on the Dounan Flower Market, a renowned wholesale flower market in Kunming, China (Huan & Dong, 2014; Sun, 2024), and the flower e-commerce/electronic commerce landscape, like online shopping platforms Taobao.com (Ye, 2022).

Proposed approach

Accordingly, to come up with eight steps, the proposed TRIZ method for PSS design was adapted from the previous study and extended in the study. We proposed a new approach that comprises three main stages. The method of input is an identified service problem.

1. At the defining stage, the problem is identified and translated into the generic requirements of TRIZ for further problem-solving. Contradiction analysis is used to structure the identified problem into typical contradictions. To eliminate contradictions, 40 inventive principles are used.

2. At the generation stage, some generated ideas are evaluated in terms of the definition of the ideal final result. Accordingly, the final outputs involve PSS systematic solutions, which consist of both conceptual products and intangible services.

3. At the embodiment stage, for systematic engineering design, visualization is used to embody product concepts and facilitate verifying the feasibility of the PSS design, which is aimed at various design representations, e.g., sketching, 3D modeling, and service blueprints.

Defining Stage

To understand contextual aspects that product design development (PDD) needs to address, the designers must investigate to identify both customer needs and marketing. In addition, involving the object's features, e.g., functionality and structures, designers are required to consider the issues of how to provide PSS design to structure the usability between users and systems by planning services, think about how providing services and physical products can be used as serviceable in a commercial networked environment, and how to maintain, extend, and/or enhance their functionality during the systematic service processes.

However, services based on company capability can't be seen as unlimited; some contradictions are thus required to be identified and eliminated.

1. *Step 1: Identify the Problem Scope*

According to customer needs, PSS design aims to develop service systems while gaining a competitive advantage in marketplaces. Therefore, both customer needs and marketing must be investigated and identified to understand the situation. Based on user-centered design, conduct marketing research with survey methods to accurately gather information. Focus on collecting information about the situation in which the systematic operations operated in the environment and analyzing it to identify the scope of the existing problem or the core requirements.

2. *Step 2: Define the Ideal Final Result (IFR)*

At present, PSS design involves a range of creative activities that heavily rely on exploring innovative solutions. There are problems for which design practitioners use problem-solving to find, analyze, and resolve them. The definition of problems helps to aim at finding factual problems involved in the PSS task. However, contradiction problems are common in not only tangible design but also service processes. This involves expressing the elementary components in the most fundamental state. In the ideal situation, define the IFR to achieve without using extra resources when contradictory problems are resolved. There is a questionnaire from the study (Chai et al., 2005) that helps define the IFR in steps. The questions are presented as follows:

1. What is the purpose of the target service?
2. What are the existing problems?
3. What are the known solutions?
4. What are the advantages and disadvantages of the known solutions?
5. What is the structure of the target service operation system?
6. What is the ideal solution to the original problem?
7. What are the local constraints or limitations?
8. What is the objective of this problem-solving project?

To identify a contradiction, address and formulate the primary problem as two types of problem statements based on the relationships in function components. There are preventive statements for harmful functions (HF) and alternative statements for useful functions (UF). An additional statement for each node can be expressed as a benefit from a harmful function, an enhancement to a useful function, or the resolution of a contradiction (Terninko et al.,1998). Figure 1 is a simple example that illustrates the use of the problem formulator in problem modeling and formulation.

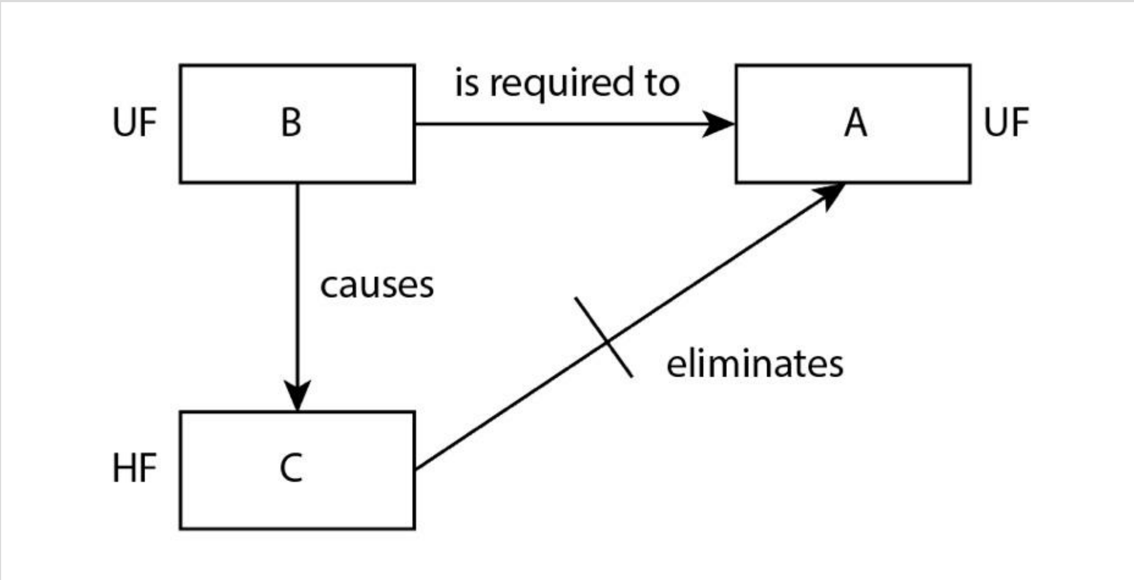

Figure 1: *The diagram of problem modeling and formulation.*

Generating Stage

The PSS system of the product itself and the services it offers with positive user experience (UX), could provide users with access to interact intuitively, i.e., a kind of implementation without excessive mental workload. By implementing the TRIZ method, many possible generic solutions can be generated with TRIZ tools involving generic guidelines, inventive principles, and parameters.

Based on the factual problems and their corresponding specific solutions, the products and services can be decomposed, respectively, into different constituting components. These function components are used to explore option parameters for evaluation analysis.

3. *Step 3 and 4: Analyze Contradictions and Identify the Corresponding TRIZ Parameters*

Identify the emerging conflicts that impede the acquisition of ideal solutions. Examine each component to see whether or not it contradicts other components. For example, service developers could refer to a common contradiction in physical aspects. Check this to determine if the application of generation solutions in the systems could result in harmful effects, such as increased costs due to higher technical requirements. In step 4, use the TRIZ contradiction matrix, in which the rows contain the parameters that have been worsened as a result of improving the parameters in the column. The matrix frames the relative TRIZ parameters, which get worse and need to be improved, and at the intersection denotes the numbers of the offered inventive principles.

4. *Steps 5 and 6: An Examination of the Inventive Principles and Generation Resolutions*

According to the matrix, the denoted numbers of the 40 TRIZ inventive principles can be gathered at the intersection of the improving and worsening parameters. After indicating the inventive principles in the step, learning the appropriate examples of the 40 TRIZ inventive principles can assist us in applying them in other particular situations. In step 6, following the indicated principles and suggested ways, generate design resolutions by eliminating contradictions and finalizing ideal concepts with a variety of discussion meetings.

Embodying Stage

5. *Step7: Embodiment Design*

The application of the visual technique in design studies involves the graphical mapping of concepts and their meaningful structuring (Bertschi et al., 2011). Visualization plays a crucial role in systematic engineering development, embodying product concepts and verifying the feasibility of the PSS design through various design representations such as sketching, 3D modeling, and 3D-printed prototypes (Yang et al., 2023). In addition to the tangible form, the PSS design encompasses both tangible and intangible services. The embodiment design involves defining the physical function components, creating graphic diagrams such as a service blueprint, and devising interactive content for its complementary services, to present interactive activities in both physical and digital environments.

6. *Step 8: Evaluate Feasible Solutions*

After the examination and presentation of some feasible solutions, the confirmed solutions can thus be implemented within developments. However, shift to sustainability aspects, Mont (2002) proposed the necessity of practical implementation and evaluation of economic, environmental, and social consequences for PSS design. Thus, the concept evaluation aims to identify promising design concepts based on the preferences of those evaluators built on environmental, economic, and social factors (Melles et al., 2011). To pursue suitability, successful PSS designs can be evaluated using the proposed criteria, e.g., use models, process, and product (cf., Yang, 2024).

Results

The design team intended to build an online/offline shopping environment for customers with an interactive, digital information service. Specifically, we aimed to provide a user-product interaction experience with the flower product service system, and we initiated the service design based on the proposals from marketing research.

Focused on value co-creation, the design aimed to enhance participatory and collaborative relationships with its flower sellers, delivery operations, and customers by building the function components, such as real-time ordering, providing flower-related products, sharing flower products, and parcel delivery operations. Developing the novel PSS concept of FFRDSS systems, in which the smart parcel delivery lockers were redesigned for the systems. The conflicts were tackled through the proposed approach to coping with the contradictions while generating intensive resolutions for innovation service.

1. *Step 1: Identification of Needs*

Based on the previous stage, we recognized that most office workers experience physical and mental stress from workloads that arise. The fast-paced modern lifestyle and rising living costs have put heavy stress on local office workers. However, these issues have remained major challenges that office workers must now confront. In response to these, the floral fragrance products produced with fresh flowers were utilized as resolutions for purifying air in the office area and offered substantial effects to benefit office workers' health. Further, taking floriculture-related products into the workspace for green natural design can improve work efficiency and creativity, relieve fatigue, and relieve stress (Deng & Deng, 2018). To meet the situation, the service design aimed to enhance the office environment by providing fresh flowers with services through the PSS design, thereby enhancing living quality and reducing anxiety among them at work.

2. *Step 2. Identify the Problem Scope*

To analyze the functions and components of existing services or products, we employed the quality function deployment (QFD) method technique (Tukker & Tischner, 2006). The method is utilized to analyze the functional relationships of a physical object between product components and their attributes in terms of exploring user needs. Based on the analysis, we concentrated on the primary useful function and developed a function analysis diagram that extended to the related problems shown in (Figure 2).

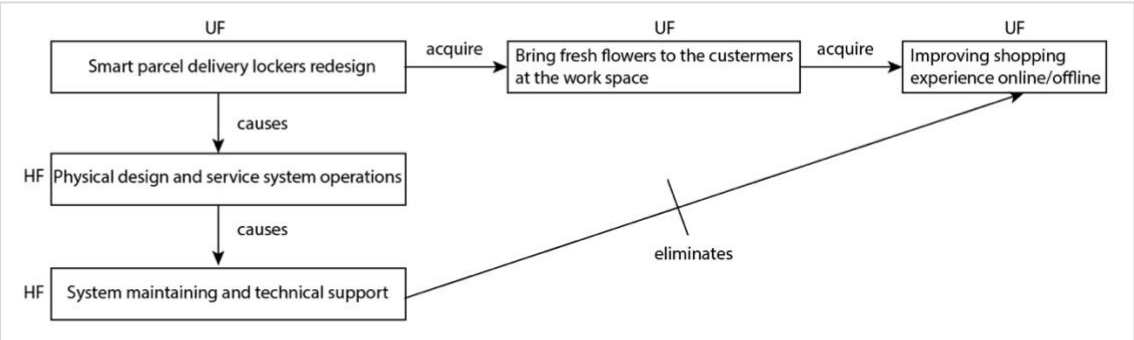

Figure 2: *The function analysis diagram.*

For the customer experience required, it was ensured that the primary useful function of the smart parcel delivery lockers (also called smart lockers) redesign is to provide system operations involving products and offered services. From these, new information technologies and smart locker solutions were allocated to the various needs of stakeholders. In this context, customer satisfaction is acquired through the useful functions (UF) of improving the availability of smart lockers and enhancing the usability of the operation systems.

However, the harmful functions (HF) are known as emergence, occurring with a corresponding increase in costs due to an increased system maintenance cost and an increased quantity of technical support. Given the existence of contradictory relationships, we defined the scope of the problem to include physical product availability, online operation usability, service system maintenance costs, and technical support costs. Following the ideals in TRIZ, we defined the smart locker systematic services as a conceptual design prototype that became an easily operated environment that users could use without any effort. Additionally, the defined FFRDSS PPS concept was used not only to provide fresh flower products to fulfill online orders from buyers but also to offer offline services like order delivery and supply.

3. *Steps 3 and 4: Analyze Contradictions and Identify the TRIZ Parameters*

Despite the increased benefits from service system developments with corresponding technique support, the derived design complexity could certainly raise and add to the total cost of the project. In the design, as we developed the operations of the smart locker and mobile user interface (UI) in a user-friendly environment, the technical costs associated with the team structure, product development, and user service provisions would increase. As a result, this contradiction was noticed due to the two issues, which certainly increased the benefits of the situation. In step 4, with the requirements, we used the design to enhance the visualization of the mobile user interfaces (UI), the reliability of the online/offline operation systems, the availability of the application operation system, its ease of use, and the interactivity within the virtual-physical operations when simultaneously using the mobile app and the smart lockers. Correspondingly, we used numbers 8, 12, 17, 27, and 33 (Table 1) as the improving parameters for the design.

Additionally, conflict arises regarding these requirements in developing and maintaining them, such as the need for a multiple-function design versus ease of use. As a result, the cost of developing and maintaining the PSS increased, leading to a complex operation and implementation process for the team. Therefore, we considered the following numbers 26, 34, and 36 as the worsening parameters for the design.

Table 1: *The engineering parameters.*

No.	Improving	Description
8	Volume	to the storage space of the smart locker
12	Shape	to the aesthetic design of the mobile user interface and the smart lockers
17	Temperature	to the storage space of the smart locker
27	Reliability	to the reliability of the online shopping system
33	Ease of operation	to the app and smart lockers operations of ease of using
35	Adaptability or versatility	to the transactional interactivity within the virtual-physical operations
No.	**Worsening**	**Description**
26	Amount of substance	to the cost of system design and maintenance
34	Ease of repair	to the difficulty of repairing the system
36	Device complexity	to the operation system of the service provider, which becomes complex

4. *Steps 5 and 6: An Examination of the Inventive Principles and Resolution Generations*

According to the TRIZ contradiction matrix, we examined the numbers of the worsened parameters and then addressed the improving parameters in the column. From these, the denoted numbers for the inventive principles were gathered. Subsequently, the intended principles were recognized by ranking the orders of the denoted numbers by their frequencies. We suggested using and adapting the particular three inventive principles to start generating design resolutions, such as segmentation, parameter changes, and local quality. In step 6, for generating solution ideas, we iteratively analyzed each of the inventive principles and examples from the related research in the previous stage, conducted discussions in the team, and generated user service divisions with the intended services as follows.

Systematic, Multi-Functional Design

The *Segmentation* item, with the sub-principle of customized marketing and autonomous region sales centers, referred to complete market/service segmentation by dividing a system into autonomous components. The designed systems introduced a concept called systematic, multi-functional design for its divisions, which aimed to provide multiple-functional, integrated online/offline product-service systems in the flower e-commerce industry. Specifically, the design focused on flower products and their corresponding service offers, which were supported by the smart lockers through app use. The design provided a range of services, including flower product ordering/sharing, and flower-related showcasing. For instance, ordering products online means that after logging in, customers can access the flower ordering page, choose flower types, prices, delivery time, and other information according to their needs, make a decision, and complete the payment. Offline, the express aspect delivers the flower products to customers based on the information they provide.

Flexibility Features for the Smart Locker

Parameter Changes with the sub-principle of changing an object's physical parameters, refers to changing physical parameters (e.g., form, temperature) to adapt to a system mechanism. This idea emphasized stability, safety, and usability when customers would see fresh flower-related products inside the cabinet at the workspace. In terms of appearance, the smart lockers could be simple and fashionable, with a transparent glass panel in a metal frame. Improved the flexibility and usability of the smart lockers in terms of ergonomics, and proposed;

1. The smart locker sets up independent storage components, each equipped with an independent door panel with smart control.

2. To accommodate different types of flowers, set the cabinet sizes according to the 3:5:8 ratios.

3. Set the body size to 1980 mm high, allowing people to reach it at a height of 1880 mm.

4. Set ventilation holes on the panel to facilitate adjusting the temperature for internal air circulation.

5. Set up the smart sensor screen for intelligent services, such as connecting the app and receiving shared flowers, or scanning the QR code to open the panel.

Adaption Design to the Local Context

Taking on the *Local Quality* principle generated two concepts to improve the office environment with office workers by constructing the fresh flower retail and delivery services through shopping online/offline.

Suitable Usability for Various User Segments

In terms of one sub-principle, making each part of an object function in conditions most suitable for its operation referred to deploying functions of the main parts in the service mechanism for its operations to achieve the goals, which meant the systems can be applied suitably for the user journey (i.e., starting before a purchase to complete) by the different three user segments, and described as followers.

1. Consumer journey with online shopping: Consumers can access the app interfaces to learn about the platform information, log in and register an account, bind personal information and the payment, search for updated flower products, and make/complete orders.

2. Consumer journey with offline shopping: Consumers can search for the nearest smart locker through the app, then arrive at the site and visit the display area, or directly purchase flower-related products by using the QR code to log in to the app and make/complete the orders.

3. Flower seller journey: They can receive orders via mobile/internet and provide cost-effective products. Then, use an app that deals with express operations to deliver the products to consumers.

4. Platform operator journey: Before the purchase, operators use the tablet app to obtain users' basic information, e.g., payment, location, and preference data, and maintain promotions to users. During the purchase, the platform operators record the consumption situation and call the express operators for delivery operations, which helps sellers complete the orders.

Design Divisions based on Useful Functions

Based on another sub-principle, making each part of an object fulfill a different and useful function, a useful function can be created and allocated to the systems. To create a relaxing and comfortable atmosphere in the workspace, the ideas were to improve flower products and surroundings with green natural elements. Relying on the Dounan Flower Market and the e-commerce business environment, the design would provide integrated, diversified, quality flower service and be described;

1. Designed flower-related products with creative floral packaging, aiming to create a relaxing and pleasant aesthetic.
2. Took on healing and green design aspects as the principles for sustainable design and combined online and offline commercial activities, app applications, and delivery services.
3. Providing a range of eco-friendly designs (Deng & Deng, 2018; Meng et al., 2022) that allow customers to purchase flowers as gifts, have them delivered to the lockers, and decorate the office environment with flowers during holidays or special occasions.

5. *Step 7: Embodiment Design*

According to sketch solutions in advance, embodiment design was undertaken using 3D computer aid design (CAD), and then the smart locker 3D prototype was created, as shown in Figure 3, which was used for reflecting in system engineering aspects. For instance, the smart operation panels facilitated self-service parcel delivery and pick-up operations. This involved a user approaching the smart lockers and entering a pick-up code to retrieve a parcel after receiving a delivery notification (via mobile or internet) from the back platform support.

Figure 3: *The created smart locker 3D prototype.*

Additionally, we created the mobile user interfaces (UI) using 2D graphic design to enable users to access service applications, as shown in Figure 4. Considering users' limited attention, focus on maximizing usability and use experience (UX) in task-oriented interface design with a minimum set of functions.

According to the designed concept, we created, schemed, and divided the service activities involved among the users (customer, service provider, seller, and delivery operator) under the shopping situation. Then, the created service blueprint sorted out how the different types of users interact in a shopping journey (Figure 5). The user journey starts when a customer intends to shop; the turning point of the online service happens when the customer makes an order. Service providers would thoroughly manage the point from online to offline, and they could add support services at the point to improve their services.

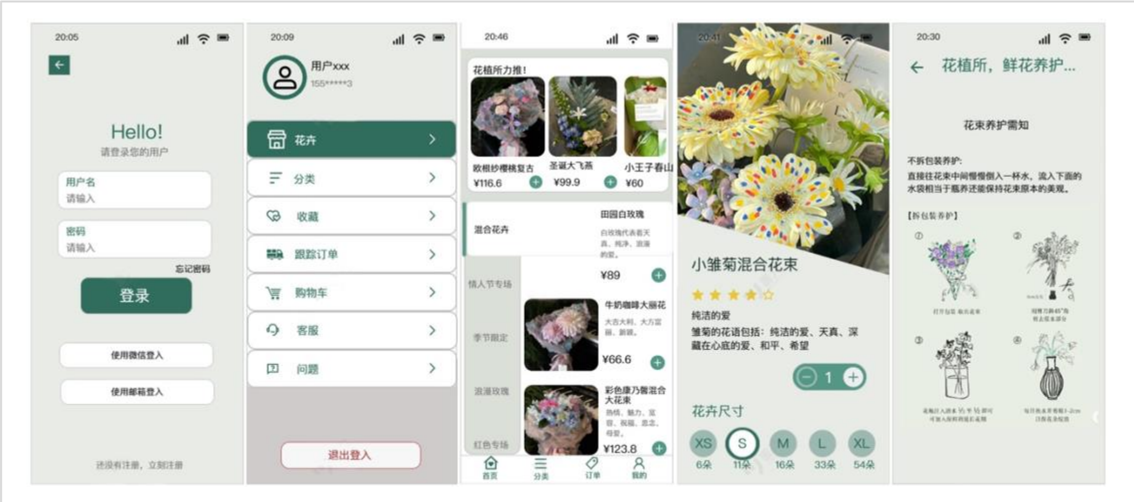

Figure 4: *The created mobile user interfaces.*

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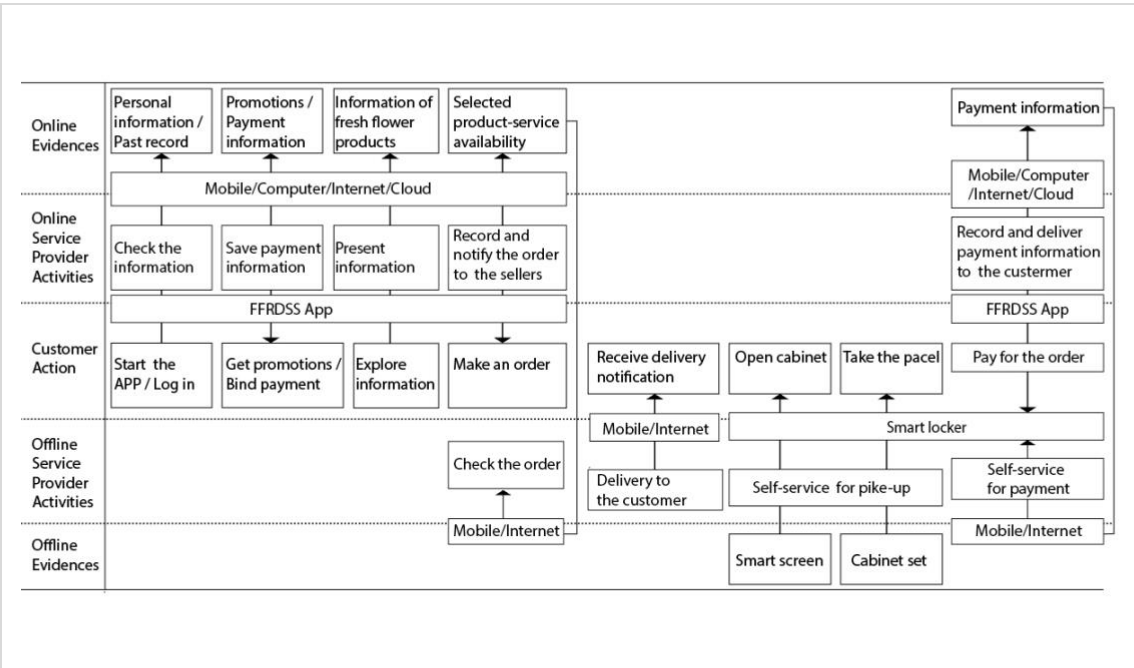

Figure 5: *The created service blueprint.*

6. *Step 8: Evaluate Feasible Solutions*

Examined the concept in the previous section by a design expert panel to discuss and evaluate it based on the criteria set by the proposed questionnaire in the previous section. Table 2 displays the summarized results. After an evaluation of the concept design from the discussion panel, the solutions were separately suggested and prioritized in terms of feasibility according to their discussion. These results were proposed to the team for the next step of execution.

Table 2: *Evaluation of the FFRDSS system concept.*

Use Models	*Advancement:* Create jobs for the service providers and other stakeholders, and develop app-based services with the users.		Empowerment: Empower the customers who live within a beautiful ecological environment in the workspace every day.	
Process	*Local Manufacture:* To develop and manufacture locally with various partners in supply chains.	*Local Control:* To manage and maintain the supply within a serviceable range locally.	*Repairing:* To repair and maintain the usability of the smart locker and related services with the platforms locally.	
Product	*Needs:* Most people in the workspace desire stress-relieving services from flower products.	*Suitability:* These provide healing effects to relieve one's stress and bring a comfortable sense to the workspace.	*Usability:* This is convenient to use with app-based service systems.	*Affordability:* Uneven distribution, aimed at urban centers, is normally supplied but not in suburban areas.

Discussion

This case study ensured that the proposed approach is feasible and effective, indicating that the TRIZ method can contribute to a new PSS concept generation for innovation services. The conducted case study achieved the design goals with a generated service concept of the FFRDSS systems, including smart parcel delivery lockers and corresponding service offers.

This PSS design could leverage the high innovation level in the digital technical system to foster service value creation, allowing stakeholders to co-create their own value. The study highlighted the embodiment design stage with evaluation compared to the previous study (Zhang et al., 2003; Chai et al., 2005), which mostly focused on the steps of *problem identification* and *idea generation*. The PSS design provided refined visual solutions through the visual design process, using some 3D modelling and graphic design techniques to present the specific details, e.g., using a 3D prototype for the smart lockers, 2D visual graphics for the mobile user interfaces (UI), and a service blueprint for the service journey. Specifically, we described the engineering solutions that visualize the interactive activities between the services and users in a cyber-physical environment. In addition, we focused on aspects of sustainable features based on expert panel discussion and evaluation. The given proposals indicated the PPS concepts were feasible for achieving sustainable aspects and the goal of value co-creation. Here, the implications of practicing the proposed approach are discussed;

1. The suggested TRIZ-based approach can facilitate the development of new PSS concepts in the innovation service area. Since the new PPS concept of a flower product service system enables the ordering/sharing of flower products, it will help extend additional services regarding fresh flower selling, and fresh flower-related product offers.

2. Customers can freely access ordering/sharing flower product services when needed, and this is an integrated way of shopping online/offline.

3. Sellers can offer cost-effective products according to customers' orders and deliver the products to consumers by delivery operations.

4. Several physical technical solutions were produced during the concept development process, and 40 inventive principles were applied.

5. The generated PPS concepts for online shopping began to address and resolve contradiction problems.

6. Some concepts rely heavily on combining flower industry backgrounds and service systems, such as the Dounan flower market.

In contrast to our previous study (Yang, 2024) on the sharing-bike service as a use-oriented PSS model, the FFRDSS integrates both product-oriented and use-oriented models, addressing common issues such as ownership and paying by use (Resta et al., 2015). The PPS features reflected the similarity between the two designs. For instance;

1. The service value proposition incorporates the PSS design and was schemed in the interactive activities with various stakeholders.
2. Encourage customers to participate in sustainable activities, such as sharing bikes for low-carbon transportation and performing the FFRDSS to promote healthy work environments.
3. The PSS systems achieve these lower environmental impacts by facilitating co-creation among various components, including the digital information platform, product providers, sellers, and delivery.

Comparing the FFRDSS reveals a main difference; the sharing-bike PPS addresses issues such as bicycles and placements, allowing service providers to quickly implement it locally without the need to produce new products for customer orders (Li et al., 2022). However, the FFRDSS PSS tends to be constrained by more external factors than others, such as building a supply chain grounded in the flower industry, logistics, and work environment, besides requiring a digital information platform. This systematic service design aims to cater to a variety of users, including customers, product providers, platform operators, and delivery operators. As a result, we integrated and implemented the envisioned value co-creation activities into the service journey map for both online and offline shopping, achieving our goals within the given context. In addition, to strengthen the system design in terms of serviceability, Ye's study (2022), suggested adopting certain aspects from different stakeholder perspectives to enhance systematic serviceability, including specifications such as:
1. Providing quality products and their supply.
2. Build a professional e-commerce team.
3. Enhance a logistics information platform for shopping online.
4. Strengthen cold chain logistics infrastructure construction. Further, we found that the design solution could challenge some factual problems and outline some predictable solution concepts for the context.

However, this still required more practical study to recognize and examine the conceptual prototype's validity. Addressing the problem of contradictions, assess if it's possible to eliminate some detrimental issues; undoubtedly, this will also maximize the benefits.

Conclusion

The results shed light on the identified contradictions in service system design and were tackled using a proposed systematic PSS design approach based on the TRIZ methodology, which is feasible and effective for innovation service. In a case study, the design team created systematic products and services, and achieved sustainable design aims and service concept generations, based on the fresh flower industry and e-commerce environment. There are increased requirements to eliminate physical and mental stress among office workers in the workspace in the local area, and these need to be challenged. Therefore, the generated service system can provide resolutions using flower-related products to improve and benefit the office environment by relieving stress at work. Specifically, future study contexts could also pay more attention to contradiction problems in the PSS concept design using the TRIZ in innovation service. This could be most beneficial for coping with conflict problems and contributing to people's health and sustainable design aspects.

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