

# Applying Theory of Inventive Problem Solving to Develop Product-Service System

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**Abstract**—Useful and innovative service design can increase organization competitiveness and consumer satisfaction. The problems facing consumers in the original open-shelf cosmetics service model includes the following issues: 1. Insufficient information on beauty goods for customers to make decisions, 2. Self-trial of products is needed but not easy to judge the quality of products, 3. It's hard to determine what's the reasonable price of the value of products, 4. To refund is full of trouble and difficulty. This study investigates the case of CSD company, applying the TRIZ (Theory of Inventive Problem Solving) to develop an innovative product-service system (PSS) for the brick cosmetic retail industry in order to enhance the customer experience and bring the crowd from online to offline. Analysis results find six TRIZ innovative principles, which are 10-prior action, 11- beforehand cushioning, 28-mechanics substitution, 32-color changes, 34-discarding and recovering, 35-parameter changes. These principles raise the conclusions and design implications for the case company.

**Keywords**—service design, TRIZ-based design, product-service systems, online to offline

## I. INTRODUCTION

By the analysis for sales of offline and online, online-shopping is the driver of the growth momentum of beauty-goods. Especially in the ups-and-downs global economic environment, the new business model is the key factor to keep the continued growth [7, 8, 11]. According to the survey data of the Institute for Information Industry in Taiwan, over 60% women using mobile-shopping in 2016. Among the shopping items, the top two categories are the clothing-accessories and cosmetics and skin care products. Mobile shopping for beauty and care products cause a huge impact on off-line stores. In the highly competitive and

rapidly changing environment, service innovation plays a key role in the way of maintaining market share and enhancing competitiveness for the firm [10, 18, 21]. The brick cosmetic retail industry suffers from the above key challenge a lot. This study investigates the case of CSD company (Cosmed) in Taiwan, applying the TRIZ (Theory of Inventive Problem Solving) to develop an innovative product-service system (PSS) for the brick cosmetic retail industry in order to enhance the customer experience and bring the crowd online to offline. In this study, the literature of PSS and TRIZ are reviewed in Chapter 2. Furthermore, the stage-by-stage service design is analyzed in Chapter 3. The contribution is finally described in Conclusion.

## II. LITERATURE REVIEW

### A. Product-Service Systems

Product-service systems (PSS) can be seen as a new selling concept in which both tangible product and immaterial services are combined to fulfill customer's needs [4, 9, 13]. In general terms, PSS is related to the commercialization of a combination of products and services that provide integrated solutions for the customers [9, 12]. PSS has three components, including products, services and software [14, 15]. Thus, the PSS-components leads to an extended complexity during the design and development of PSS because it needs the integration of diverse information associated with different domain professional knowledge [13, 14]. Due to the heterogeneity during the development of PSS, the selection of actors to develop PSS is a major challenge to integrate service, product and even software [3, 9]. During a PSS's concept design and development, different professional knowledge is essential in order to create innovative, value-oriented PSS-concepts [14]. Hence, very different professional expertise is needed, depending on the respective service [15]. Several studies suggest that offer of PSS, both in the manufacturing industry as service providers, can occur basically in three main types, including "product-

oriented” PSS, “use-oriented” PSS, and “result-oriented” PSS [14].

### B. TRIZ

TRIZ (Theory of Inventive Problem Solving) was proposed by the Russian researcher, Altshuller (1984), who found that very creative patents solve “creative” problems, which usually have the features of paradoxical and conflicting demands [1, 5]. TRIZ is a unique way of systematic thinking with a useful knowledge-base as its foundation [2]. Therefore, TRIZ is helpful for generating breakthrough ideas and delivering solutions. Altshuller summarized 39 frequently-encountered engineering parameters of technical contradiction. These 39 engineering parameters can be used to define problems. These parameters can create a 39X39 contradiction matrix [2, 5, 6]. R&D or design personnel can check the matrix to find the principles that can be used in TRIZ when their inventions have contradictory elements. Altshuller also summarized 40 principles of invention (see Table 1) from these patents, corresponding to the contradiction matrix. R&D or design personnel can follow the principles to carry out innovative solutions under the situation with less experiences [5,19, 20].

TRIZ-based method is adopted as the service design method, and lack of review on using the method on the service design of PSS [15]. Thus, it is adopted for the case in this study to explore the new era. The TRIZ-based method allows the design of new and inventive services focusing on defining and solving business problems with non-

experiential domain background using the knowledge base [5, 6].

### III. RESEARCH METHODOLOGY AND IMPLEMENTATION

The research analyzes the existing service process of the Cosmed brick cosmetics retail chain stores and summarizes problems faced by cosmetics consumers[22, 23, 24]. It is an open-shelf type cosmetics store that customers can choose and try needed product by themselves. Following [16, 17] who transformed the original TRIZ engineering parameters into service parameters, this study generates and interprets the related service parameters in the brick cosmetics industry. TRIZ contradiction analysis is applied to generate innovative solutions.

#### A. Problem Analysis of Existing Service Processes.

For consumers of buying beauty products, the actual experience plays an important role while deciding to buy. Consumers always cannot judge the right or wrong of information from the web. Product knowledge obtaining from beauty counter passage are not rich and deep enough to do purchasing decision. Thoughts after trial, such as skin-contact feeling or makeup effect, and price incentives are the key issue to make a purchase. After customers’ shopping, they are expecting to have good after-sale service, especially when they encounter a problem while using beauty products. After all, cosmetics and skin care products belong to those products with expectation of before-and-after difference.

Table 1: List of TRIZ 40 invention principles

No.	Principles of TRIZ	No.	Principles of TRIZ
01	Segmentation	21	Rushing through
02	Extraction, separation, removal, segregation	22	Convert harm into benefit
03	Local quality	23	Feedback
04	Asymmetry	24	Mediator
05	Combining, integration, merging	25	Self-service, self-organization
06	Universality, multi-functionality	26	Coping
07	Nested doll	27	Disposable
08	Counterweight	28	Replacement of mechanical system
09	Prior counteraction	29	Pneumatic or hydraulic construction
10	Prior action	30	Flexible membranes or thin films
11	Cushion in advance, prior counteraction	31	Porous material
12	Equipotentiality, remove stress	32	Changing the color
13	Inversion, do it in reverse	33	Homogeneity
14	Spheroidality, curvilinearity	34	Rejecting and regenerating parts
15	Dynamicity, optimization	35	Transformation of properties, parameter change
16	Partial or excessive action	36	Phase transition
17	Transition into a new dimension	37	Thermal expansion
18	Mechanical vibration	38	Accelerated oxidation, enriched atmospheres
19	Periodic action	39	Inert environment
20	Continuity of useful action	40	Composite materials

The products of whitening, removing wrinkles, eye cream, skin-care cream, sunscreen etc., have the issue about the effect about what customers feel. If they encounter problems in use or just don't feel good about effects, the dissatisfaction of customer expectation will happen. However, customers' complaints about effects of these kinds of products are usually not easy to take handling or recovery action [7, 25]. Therefore, an analysis of problems facing in the original service mode includes the following issues:

1. Insufficient information on beauty goods for customer to make decision.
2. Self-trial of product is needed but not easy to judge the quality of products.
3. It's hard to determine what's the reasonable price they should pay for the products based on the value of product.
4. Customers have difficulty to refund based on the dissatisfactory effect they claimed.

After carrying out the problem analysis, we can catch up the context of root cause and innovation direction for solving problems. In order to break through to higher level of service quality, CSD considered using the technology of mobile apps and experiential technology to improve the service failure points of current selling service.

#### *B. TRIZ parameter analysis for the cosmetic and drug industry*

Following the literature and based on the above results of problem analysis, we generate and interpret the relevant service parameters for the cosmetic industry as shown in Table 2.

1. Responsiveness: for open-shelf type cosmetics store that customers rely on choosing and trying needed product by themselves. Thus, increasing responsiveness is perceived as increasing the efficiency of product-introducing and product-testing procedures.
2. Exterior: for open-shelf type cosmetics store, store appearance, decoration, product stand and information display will attract customers to come into brick stores instead of buying online. Being comfortable, tiny and with information transparency is needed.
3. Service ability: it means the ability to provide the right knowledge and information by customers' requests and demands, and make them purchase.
4. Waiting time: it means the waiting time for choosing the product spec, product brand, product functionality and price. At peak times, customers may be kept waiting for service.
5. Reliability: Reliability of information service for products.
6. Communication: Ability to listen to customers' voices and deliver useful product or promotion information for customers.

Moreover, adapting personal communication methods to different consumers.

7. Taking the initiative to provide customers the necessary information: Automation services based on customers' requirements, such as self-virtual-testing, product suggestion, and guidance to product shelves.

#### *C. TRIZ Contradiction Matrix for the Cosmetics Retailing Industry*

According to the TRIZ-based service parameters in Table 1, we apply the TRIZ contradiction matrix of innovative principles to find the solution principles. By examining the cross matrix code of the original TRIZ theory, we can construct the TRIZ-based contradiction matrix of the case. Intersections of the two axes in the grid correspond to the numbers of the original TRIZ contradiction matrix, which point out the solution. According to the problems which are extracted and defined in the previous stage, the top six principles were chosen in the contradiction matrix as follows: No.10 (Prior action) No.11 (Beforehand cushioning), No.28 (replacement of mechanical system), No. 32 (changing colors), No.34 (Discarding and recovering) and No.35 (Parameter changes) (as shown in Table 3).

By these principles, this research can discover how to achieve these principles in the design of the new service system. The original engineer parameters are transferred into service interpretation for the cosmetics industry point by point in Table 3. From this table, we can understand how to achieve these innovative principles for service design. Moreover, these innovative principles can be designed as 3 modules, namely (1) virtual makeup service, (2) guide to buy and (3) skin examination and product suggestion. The results of service design are discussed in the conclusion section. Analysis results raise the following conclusions and design implications:

1. When entering into the store and browsing cosmetics products: CSD should establish new makeup demonstration and training interaction approach, such as photo taking and download to mobile App, makeup product selection. Virtual makeup techniques can be applied to analyze customer's face and make them know the face after making up. Moreover, the results can be linked to social media sharing and fitted product recommendation. This concept contributes to a product-oriented and result-oriented PSS [14] to show the result of products.
2. When going to find the shelf of needed products: CSD should use indoor-guidance technology to show the direction to the shelf of selected products or recommendation products. Moreover, CSD can precast marketing information when consumers are close to the specific location of their preference products. This concept contributes a product-oriented and use-oriented PSS [14] to guide customers easily go to find the products before buying.

Table 2: TRIZ-based service parameter

TRIZ parameter Number	Engineering parameter	Service Parameter	Interpretation for specific beauty-product domain
9	Speed	Responsiveness	Efficiency of product introducing and testing service
12	Shape	Exterior	Store appearance, product stand and information display
14	Strength	Service ability	Technical and professional knowledge related to cosmetic
25	Loss of time	Waiting time	Waiting time for service
27	Reliability	Reliability	Reliability of sales service and product effects
28	Measurement accuracy	Communication	Responsiveness to customer input
38	Extent of automation	Taking the initiative to provide customers the necessary information	Self-service for cosmetic industry

Table 3: Interpretation of TRIZ innovative principles for the cosmetics industry

TRIZ innovative principle number	TRIZ principles applied	Engineer Interpretation	Service interpretation for the cosmetics industry
10	Prior action	<ul style="list-style-type: none"> <li>· Perform the required change of an object before it is needed.</li> <li>· Pre-arrange objects so that they can come into action from the most convenient place and without losing time for their delivery.</li> </ul>	Cosmed can pre-handle customer needs to enhance efficiency, such as to integrate multiple functions in the same environment to provide a service that meets the needs of most customers or to collect customer feedback in a standardized way.
11	Beforehand cushioning	<ul style="list-style-type: none"> <li>· Prepare emergency means beforehand to compensate for the relatively low reliability of an object.</li> </ul>	<p>Cosmed can provide beforehand strategy to balance service ability and customer uncertainty.</p> <p>Cosmed can provide emergency handling and customer handling services.</p>
28	Mechanics substitution	<ul style="list-style-type: none"> <li>· Replace a mechanical means with a sensory (optical, acoustic, taste or smell) means.</li> <li>· Change from static to movable fields.</li> </ul>	Cosmed can deploy a new service interface to build up a closer partnership and an additional data analysis mechanism.
32	Color changes	<ul style="list-style-type: none"> <li>· Change the color of an object or its external environment</li> <li>· Change the transparency of an object or its external environment.</li> </ul>	Cosmed can deploy a new environment mood, such as changing the color or decoration style of the external environment, or changing the light to be lighter, darker or using display technology to give environment different color to change different mood.
34	Discarding and recovering	<ul style="list-style-type: none"> <li>· Discard the portions of an object that have fulfilled their functions.</li> <li>· Restore consumable parts of an object directly in the operation.</li> </ul>	Cosmed can use a convenient facility to enhance efficiency, such as using convenient facilities that can be replaced anytime, or updating product contents quickly.
35	Parameter changes	<ul style="list-style-type: none"> <li>· Change an object's physical state</li> <li>· Change the concentration or consistency</li> <li>· Change the degree of flexibility</li> </ul>	Cosmed can employ an effective process to build up closer partnerships and to enhance customer satisfaction, such as providing simple ordering procedures, or providing quick payment.

3. Choosing the skin-care product and skin examination: CSD should use the color frame and skin analysis to provide personal preference selection of skin products. Moreover, providing skin product scanner and then showing product demonstration can lead customers to test products step by step. Thus, customers' self-service quality will be enhanced to make purchasing decision easily. This concept contributes a product-oriented and use-oriented PSS [14] to recommend customers to select proper products and test products easily.

#### IV. Conclusion

This study uses TRIZ-based service design methodology to find out how to carry out a new PSS (Product-Service System) model and new service encounter for the cosmetic

industry. By obtaining TRIZ innovative principles, a new system framework was proposed and designed as three modules, namely virtual makeup service, guide to buy and skin examination and product suggestion in the process of (1) entering into the store and browsing cosmetics products, (2) going to find the shelf of needed products, and (3) choosing the skin-care product. This academic paper is an empirical case study of an enterprise in Taiwan as it tries to solve the performance and design for new services in its retail stores by using a knowledge-based systematic design approach. It contributes to enriching the TRIZ application in the service design domain and in the cosmetic industry. Moreover, it also extends the range of TRIZ applications for the PSS systems, in-store shopping and the virtual makeup technique.

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