World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:10, No:2, 2016

Applying Theory of Inventive Problem Solving to Develop Innovative Solutions: A Case Study

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***Abstract*—**Good service design can increase organization revenue and consumer satisfaction while reducing labor and time costs. The problems facing consumers in the original serve model for eyewear and optical industry includes the following issues: 1. Insufficient information on eyewear products 2. Passively dependent on recommendations, insufficient selection 3. Incomplete records on progression of vision conditions 4. Lack of complete customer records. This study investigates the case of Kobayashi Optical, applying the Theory of Inventive Problem Solving (TRIZ) to develop innovative solutions for eyewear and optical industry. Analysis results raise the following conclusions and management implications: In order to provide customers with improved professional information and recommendations, Kobayashi Optical is suggested to establish customer purchasing records. Overall service efficiency can be enhanced by applying data mining techniques to analyze past consumer preferences and purchase histories. Furthermore, Kobayashi Optical should continue to develop a 3D virtual trial service which can allow customers for easy browsing of different frame styles and colors. This 3D virtual trial service will save customer waiting times in during peak service times at stores.

***Keywords*—**Theory of inventive problem solving, service design, augmented reality, eyewear and optical industry.

I. Introduction

GOOD service design can increase organization revenue and consumer satisfaction while reducing labor and time costs. Many companies are adopting new technologies in an attempt to address operational challenges. The eyewear industry suffers from two key challenges: 1) Firms purchase large quantities of lenses and frames, and low inventory turnover rates burden companies with high inventory costs; 2) firms have difficulty accurately matching group-wide purchasing with the different needs of each retail location. Moreover, retail stores routinely stock over 100 different types of eyewear frames, making it difficult for consumers to choose, and leaving them reliant on recommendations from store staff and increasing the difficulty of anticipating inventory replenishing needs. This study investigates the case of Kobayashi Optical, applying the TRIZ to develop innovative solutions the eyewear and optical industry.

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II. Literature Review

A. Augmented Reality (AR)

Augmented reality (AR) refers to computer displays that layer virtual information over the user's perception of the surrounding real-world environment. AR systems employ some of the same hardware technologies used in virtual-reality research, but with a crucial difference: whereas virtual reality aims to replace the real world with a digital landscape, augmented reality supplements the real world with digital information [1].

Milgram and Kishino defined Milgram's Reality-Virtuality Continuum (Fig. 1) as stretching from the real environment to a pure virtual environment. In their view, Augmented Reality is closer to the real environment while Augmented Virtuality is closer to the virtual environment. At the left extreme of the continuum, the environment consists entirely of real objects, and includes whatever might be observed when viewing a real-world scene. At the extreme right, the environment consists solely of virtual objects, examples of which would include conventional computer graphic simulations [2].

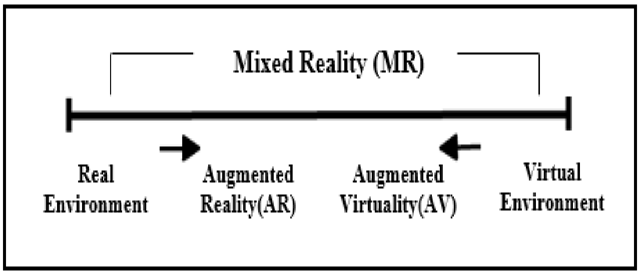

Fig. 1 Simplified representation of a RV Continuum

The retail landscape is overcrowded and customers have become desensitized to traditional marketing methods. Augmented reality has the power layer additional information in the form of images, text and video over products, labels or even shop window [3]. Augmented reality makes the virtual dressing room a reality. For example, TryLive, the next generation of 3D product visualization and virtual try-on solutions for the retail and e-commerce sectors, allows users to experience enhanced and social shopping at home, in the store and on the go. Using a camera-equipped computer, tablet, or smartphone, shoppers can virtually try on eyewear, apparel, jewelry, and watches [4].

B. TRIZ

TRIZ was developed by the Soviet inventor and science fiction writer Genrich Altshuller and his associates in 1946 [5].

They collected and analyzed over 100,000 patents to identify patterns of innovation in the development of technical systems. Through deduction, analysis, and classification of unique process conflict resolution, they developed a systematic and highly feasible theory for product design to assist in the development of new product design, and to improve existing product features and appearance.

TRIZ theory suggests that "conflict" is a key obstacle to the continuous evolution of technical systems. In general, product developers encounter conflicts in the design phase, compromising the system and preventing further progress. Altshuller proposed using a Contradiction Matrix to resolve this type of problem. The TRIZ concept of Ideal Final Result (IFR) is to achieve the desired functionality in an as-yet undeveloped system through the use of functions in existing systems. As the system approaches the IFR, time and cost inputs are reduced, and the emergent system is more reliable and cost-effective [6], [7]. The IFR has the following characteristics:

1. Eliminates the shortcomings of the original system.
2. Retains the advantages of the original system.
3. Does not further complicate the system. (i.e., uses free or available resources)
4. Does not introduce new shortcomings.

TABLE I
TRIZ CONTRADICTION MATRIX

Worsening parameter / Improving parameter	1. Weight of moving object	2. Weight of stationary object	3. Length of moving object	...	39. Productivity
1.Weight of moving object	N/A	N/A	15,8,29,34	...	35,3,24,37
2. Weight of stationary object	N/A	N/A	N/A	...	1,28,15,35
3.Length of moving object	8,15,29,34	N/A	N/A	...	14,4,28,29
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
39.Productivity	35,26,24,37	28,27,15,3	18,4,28,38	...	N/A

Altshuller analyzed and summarized 39 frequently - encountered engineering parameters for technical contradictions. These 39 engineering parameters can be used to define problems by creating a 39X39 contradiction matrix as shown in Table I [8]. R&D personnel can then check the matrix to identify principles that can be used in TRIZ when their inventions include contradictory elements. Altshuller also summarized 40 principles of invention corresponding to the contradiction matrix.

III. Research Methodology and Implementation

This research analyzes the existing service model of Kobayashi Optical and Optical and summarizes problems faced by eyewear consumers. Following [9] who transformed the original TRIZ engineering parameters into service parameters, this study generates and interprets the related service parameters in the eyewear and optical industry. TRIZ contradiction analysis is applied to generate innovative solutions.

A. Problem Analysis of Existing Service Processes

When consumers enter Kobayashi Optical retail stores, an optometrist will first confirm their prescription. Then, store staff will recommend different lenses and frames. Given the limited range of frames on display in the store, salespeople are encouraged to use their own subjective judgment in making recommendations. Selection will naturally be limited by consumer preference, but consumers generally lack sufficient knowledge in regard to lenses and rely on staff expertise in making a selection. Therefore, an analysis of problems facing consumers in the original serve model includes the following issues:

1. Insufficient information on eyewear products.
2. Passively dependent on recommendations, insufficient selection.
3. Incomplete records on progression of vision conditions.
4. Lack of complete customer records.

B. TRIZ Parameter Analysis for the Eyewear and Eyewear and Optical Industry

Following [9], we generate and interpret the relevant service parameters for the eyewear and optical industry as shown in Table II.

1. Responsiveness: the quality of customer service and business efficiency largely relies on the company's ability to provide timely service. Increased responsiveness is perceived as increased efficiency by the consumer.
2. Professional capacity: In the optical industry, the optometrist's professional competence and the expertise of store personnel is a key issue in that consumers rely on them to provide correct and relevant information.
3. Brightness: With adequate lighting provided to ensure the environment is comfortable and perceptibly tidy. Another, invisible, aspect of brightness is related to information transparency, providing the consumer with a clear understanding of the product.
4. Effort: Employee effort is often hidden from the customer's view, and staff attitude is frequently taken as a proxy for effort.
5. Wait time: Selection and fitting of eyewear can be a time-intensive process. At peak times, customers may be kept waiting for service.
6. Service capabilities: When problems arise, staff can demonstrate good service capacity through providing effective and timely resolution.
7. Flexibility: Adapting different marketing methods to different consumers.

8. Performance: Overall performance includes staff performance, and customer satisfaction and assessment.

C. TRIZ Contradiction Matrix for the Eyewear and Optical Industry

According to the TRIZ-based service parameters in Table II, we apply the original TRIZ contradiction matrix of innovative principles to find the solution principles. Examining the cross matrix code of the original TRIZ theory, we can construct the TRIZ-based contradiction matrix of this case. Intersections of the two axes in the grid correspond to the numbers of the original TRIZ contradiction matrix, which point to the solution [10].

Following the problems extracted and defined in the previous stage, the top five TRIZ principles are chosen in the contradiction matrix as follows: No. 10 (prior action), No. 1 (segmentation), No. 35 (transformation of properties), No. 32 (changing the color), No. 28 (replacement of mechanical system) (Table III).

TABLE II
INTERPRETATION OF TRIZ PARAMETERS FOR THE EYEWEAR AND EYEWEAR AND OPTICAL INDUSTRY

TRIZ parameter number	Engineering parameter	Service parameter	Interpretation for the eyewear and eyewear and optical industry
9	Speed	Responsiveness	Salesperson service efficiency
14	Strength	Professional competence	Technical and professional knowledge related to eyewear
18	Illumination intensity	Environmental quality	Tidy environment (visible) Provide clear information (invisible)
21	Power	Effort	Staff attitudes
25	Loss of Time	Waiting Time	Waiting time for service
28	Measurement accuracy	Communication	Responsiveness to customer input
34	Ease of repair	Service capabilities	Ability to respond to customer requests and needs
35	Adaptability or versatility	Service elasticity	Personalized service
39	Productivity	Service performance	Service performance in the eyewear and optical industry

TABLE III
INTERPRETATION OF TRIZ INNOVATIVE PRINCIPLES FOR THE EYEWEAR AND OPTICAL INDUSTRY

TRIZ innovative principle number	Engineering Interpretation	Service interpretation for the eyewear and eyewear and optical industry
10	• Perform required change before needed • Pre-arrange objects such that they can be accessed without delay.	• Kobayashi Optical can create records of consumer purchases. Data mining techniques can then be applied to drive promotions which will increase consumer willingness to buy. • Provide cross-store pickup services, allowing consumers to shop at store A and pick up the product at store B.
1	• Divide an object into independent parts. • Make an object easy to disassemble. • Increase the degree of fragmentation or segmentation.	• Build a database of frames and lenses according to color, material and other relevant classifications.
35	• Change an object's physical state (e.g. to a gas, liquid, or solid.) • Change the concentration or consistency. • Increase the degree of fragmentation or segmentation	• Provide different information based on customer type (e.g., general customers vs. members).
32	• Change the color of an object or its external environment • Change the transparency of an object or its external environment.	• Kobayashi Optical can provide consumer with a wider selection of frame colors and styles. • Kobayashi Optical can provide consumers with greater information transparency in terms of frames and recent promotional activities. • Provide consumers with better product information.
28	• Replace a mechanical means with a sensory (optical, acoustic, taste or smell) means. • Use electric, magnetic and electromagnetic fields to interact with the object. • Change from static to movable fields, from unstructured fields to those having structure. • Use fields in conjunction with field-activated (e.g. ferromagnetic) particles.	• Kobayashi Optical can create records of consumer purchases, and apply data mining techniques to analyze customer demand, allowing the firm to provide more expert information and advice, thus improving service efficiency. • Facial detection can be used to provide consumers with composite virtual images of different frames superimposed over their face. • Somatosensory input methods can be used to allow consumers to switch frame style and color using hand gestures.

IV. CONCLUSIONS

This study uses a TRIZ-based service design methodology to develop innovative solutions for the eyewear and optical industry. The paper expands on TRIZ-based service design in different service industries and contexts. This research also contributes the service design literature, and extends the range of applications for the eyewear and optical industry.

Analysis results raise the following conclusions and management implications:

1. Kobayashi Optical should establish customer purchasing records. Data mining techniques can be applied to analyze past consumer preferences and purchase histories to provide customers with improved expert information and recommendations, thus improving overall service efficiency.
2. Kobayashi Optical should continue to develop a 3D virtual trial service, using somatosensory detection methods to allow for easy browsing of different frame styles and colors. This will reduce customer waiting times in during peak service times at stores.

3. The 3D virtual trial service should be developed as a mobile APP, allowing customers to try out different frames in the store while providing relevant information and personalized promotions.

ACKNOWLEDGMENT

This study was conducted as part of the Smart Retail Store Design and Implementation Project at the Institute for Information Industry, which is partially funded by the Ministry of Economic Affairs, Republic of China (MOEA, R.O.C.).

This research was partially supported by the Ministry of Science and Technology research grant (MOST 104-2629-E-027-001 -).

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