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

Y. H. Wang, C. C. Hsieh

Abstract—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 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 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.

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.

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<td>1. Weight of moving object</td>
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<td>3. Length of moving object</td>
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<td>...</td>
<td>14,4,28,29</td>
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<tr>
<td>39. Productivity</td>
<td>35,26,24,37</td>
<td>28,27,15,3</td>
<td>18,4,28,38</td>
<td>...</td>
<td>N/A</td>
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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 customer 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 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.

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

TABLE III

<table>
<thead>
<tr>
<th>TRIZ innovative principle number</th>
<th>Engineering Interpretation</th>
<th>Service interpretation for the eyewear and eyewear and optical industry</th>
</tr>
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<tbody>
<tr>
<td>10</td>
<td>Perform required change before needed</td>
<td>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.</td>
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<tr>
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<td>Pre-arrange objects such that they can be accessed without delay</td>
<td>Provide cross-store pickup services, allowing consumers to shop at store A and pick up the product at store B.</td>
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<td></td>
<td>Divide an object into independent parts.</td>
<td>Build a database of frames and lenses according to color, material and other relevant classifications.</td>
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<td></td>
<td>Make an object easy to disassemble.</td>
<td>Increase the degree of fragmentation or segmentation.</td>
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<tr>
<td></td>
<td>Change an object's physical state (e.g. to a gas, liquid, or solid.)</td>
<td>Build a database of frames and lenses according to color, material and other relevant classifications.</td>
</tr>
<tr>
<td>35</td>
<td>Change the concentration or consistency</td>
<td>Provide different information based on customer type (e.g., general customers vs. members).</td>
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<td>Increase the degree of fragmentation or segmentation</td>
<td>Increase the degree of fragmentation or segmentation.</td>
</tr>
<tr>
<td>32</td>
<td>Change the color of an object or its external environment</td>
<td>Change the color of an object or its external environment.</td>
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<tr>
<td></td>
<td>Change the transparency of an object or its external environment</td>
<td>Replace a mechanical means with a sensory (optical, acoustic, taste or smell) means.</td>
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<td>Use electric, magnetic and electromagnetic fields to interact with the object</td>
<td>Use electric, magnetic and electromagnetic fields to interact with the object.</td>
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<td>Change from static to movable fields, from unstructured fields to those having structure.</td>
<td>Change from static to movable fields, from unstructured fields to those having structure.</td>
</tr>
<tr>
<td>28</td>
<td>Use fields in conjunction with field-activated (e.g. ferromagnetic) particles</td>
<td>Use fields in conjunction with field-activated (e.g. ferromagnetic) particles.</td>
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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

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REFERENCES