HAWK-DOVE GAME BASED INTERACTIVE DESIGN TO MANAGE CUSTOMER EXPECTATION

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Abstract

In the era of experience economy, how best to deliver memorable and exciting customer experiences has become a key issue for service providers, and customers can involve themselves in service experience delivery by actively deciding appropriate services rather than passively accepting existing ones. However, service providers frequently consider profit and cost first despite knowing that high-quality service can maximize satisfaction. A dilemma emerges particularly in the oligopoly market. Oligopoly service providers generally have no need to expend additional efforts and costs in attracting customers, and thus are considered a value-bounded context for customers in which providers only provide customers with existing services and restricted values. Accordingly, this study devises an interaction design mechanism to assist oligopoly service providers in effectively managing customer expectations within the dynamic interactions even in value-bounded contexts. The proposed mechanism models this interaction design problem as a series of Hawk-Dove games toward an evolutionary stable state. The simulation results suggest that oligopoly service providers should change their original mindset and design the interactions to manage customer expectations within the service experience delivery to not only achieve high satisfaction and profit but also engage customers to co-create the values.

Keywords: Hawk-Dove game, customer expectation management, oligopoly, interaction design, service experience.

1   INTRODUCTION

Oligopoly is a common market structure in markets characterized by imperfect competition. As a result of the global division of labor and economic slump, numerous industries have transformed into oligopolies through mergers and alliances. For example, the merger of Google and YouTube provides a famous case of an oligopoly involving online portal sites. An oligopoly market involves far fewer sellers than buyers. Oligopoly service providers frequently dominate customer interactions while producing and designing their services. Service providers primarily focus on competition rather than considering customers. Additionally, oligopoly service providers generally lack a long-term perspective on value co-creation with their customers, leaving customers with no choice but to accept existing service provider services. Accordingly, an oligopoly market can be considered a value bounded context in which customer value is limited in terms of the bounded number of various available services offered by the oligopoly service providers or the bounded resources expended on customer service.

In the experience economy, service providers need to understand customer needs to create memorable service experiences, and customer expectations are considered critical during service experience delivery (Pine and Gilmore, 1999). Managing customer expectations thus is critical to successfully achieving customer satisfaction. Service providers can define and operate competitive services related to customer expectations to increase their market competency (Pitt and Barbara, 2004; Schurter and Towers, 2006). Service providers can attempt to provide good experiences and design appropriate customer interactions by managing customer expectations without significantly damaging revenue. This differs from the dilemma in which service providers must decide whether to attempt to increase service options or reduce price, and both involve complex market issues such as market share and existing competition.

This study presents an interaction design mechanism for managing customer expectations by providing the oligopoly service providers with directions on how to fulfil customer requirements during service encounters. This study fulfils two objectives, as follows. First, this work proposes a quantitative mechanism to enable service providers to monitor and direct customer interactions during service encounters to manage customer expectations and ensure customer satisfaction. Second, this study also performs simulation experiments to demonstrate the performance and feasibility of applying the proposed mechanism to oligopoly service providers and clarify the extent of value co-creation in the value bounded context.

2   RELATED WORKS

2.1   Customer Expectation

A dual-level (namely desired and adequate levels) and dynamic model of customer expectations offers the optimal means of characterizing those expectations (Parasuraman et al., 1991). The desired and adequate expectation levels refer to the service level the customer hopes to receive and that the customer finds acceptable, respectively. The desired level is a combination of what the customer believes the product "can be" and what it "should be". On the other hand, the adequate level is partially based on "predicted service" level of the customer, namely, the customer appraisal of what service "will be". The zone of tolerance can vary among customer, and even in the same customer among different situations.

Understanding customer expectations requires service providers to successfully reach the customer franchise (Rust et al., 1999; Parasuraman et al., 1991). The multiple expectations conceptualization influences the resource allocation of service providers (Walker and Baker, 2000). This study implements customer expectation management to provide governance for exercising the expectation determinants and thus expectation levels. Service providers can meet customer expectations and achieve customer satisfaction provided they deliver services in a manner that considers the expectation determinants. Managing customer expectation thus is incorporated into the proposed

interaction design mechanism, thus affecting the service delivery process and ensuring customer satisfaction.

2.2 Hawk-Dove Game

In nature, individuals must forage and sometimes fight for food. The Hawk-Dove game is one application of game theory to animal behaviors (Kokko et al., 2006). The game describes the situation in which contestants can select either an aggressive (namely Hawk) or non-aggressive strategy (that is Dove) to compete for a collective resource. For example, Hawks use every opportunity to steal or defend the food, while Doves never steal or resist. These two birds thus comprise a polymorphic population. Mathematically, the Hawk-Dove game is a non-zero sum matrix game with the payoff matrix listed in Table 1, where V denotes the value of the contested resource, C represents the cost of escalated fight (Smith and Parker, 1976), and the resource value is assumed to be less than the cost of a fight (namely $C > V > 0$).

The payoff matrix reveals four possible fight situations. In the first case, when Hawk encounters Hawk, the winner obtains a resource with value V while the loser bears the cost of fight C, or equally both participants share the cost of fight C/2. In the second case, when Hawk meets Dove, the Hawk monopolizes the entire resource and leaves the Dove with nothing. In the third case, when Dove meets Hawk, the Dove receives no resource from the Hawk. In the fourth and final case, two Doves meet each other and share the value of the resource with V/2.

	Hawk	Dove
Hawk	(V-C)/2, (V-C)/2	V, 0
Dove	0, V	V/2, V/2

Table 1. The basic payoff matrix of Hawk-Dove game

The relationship between V and C yields different results in terms of population equilibrium. Equilibrium denotes the optimal combination of strategies adopted by game participants. Through approaching equilibrium, players can achieve the optimized value. In the aforementioned classic Hawk-Dove game, if $C > V > 0$, the proportion of individuals in the population adopting the Hawk strategy tends to equal to V/C as the equilibrium. (If $C < V$, the environment is more favorable to Hawks but this factor is not considered in this study.). Each individual considers value and cost in deciding which strategy to adopt. Meanwhile, strategy selection may eventually approach a stable evolutionary state (so-called ESS). ESS is crucial in strategy selection owing to the evolutionary dynamics (namely, enabling strategy selection to occur in continuous time) within a simple game-theoretical framework (that is, a restricted equilibrium concept for a two-player game) (Berninghaus and Ehrhart, 2003). The concept of ESS involves characterizing specific Nash equilibriums that are immune to the invasion of mutant strategies and were developed during the 1970s (Smith and Price, 1973). ESS equilibrium was shown to be sufficiently strong to attract players who could perform better in other equilibriums such as the dominated equilibrium (Berninghaus and Ehrhart, 2003) particularly when players who are not fully informed regarding the payoff functions were unaware that they were selecting an ESS.

In this study, we apply the Hawk-Dove game to simulate cost and value among oligopoly service providers and customers to examine strategy selection in the game. The evolutionary dynamics involved between games is considered to be based on continued interactions between provider and customers within service delivery, and thus the ESS equilibrium is also adopted to guide strategy selection.
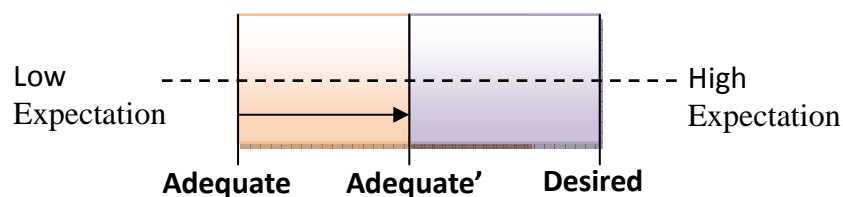

Figure 1. The objective of customer expectation management

3   EXPECTATION MANAGEMENT OBJECTIVE

The purpose here is to explore a little further into the aim of the expectation management of the proposed control framework. According to the dual leveled expectation model (Parasuraman .etc, 1991), customers' service expectations have two levels: desired and adequate. For the high competence service providers in oligopoly market, the goal of the expectation management in the proposed control mechanism is to raise the adequate level expectation and stabilize the desire level expectation.

Competent service providers servicing the oligopoly market can manage customer expectations by raising the adequate expectation (e.g., from Adequate to Adequate') and stabilizing desired expectations to reduce the tolerance zone (as shown in Fig. 1) that thus increases the barriers to competition. For example, since Apple uses branding and promotion raise customer expectations of its product, customers expect the product to be superior to alternatives. Customer loyalty proves that Apple has successfully managed customer expectations by raising them, and occupied a special position in the market for computer systems.

4   HAWK-DOVE GAME BASED INTERACTION DESIGN MECHANISM

This study attempts to design an interaction design mechanism that oligopoly service providers can use to manage customer expectations during service encounters. The mechanism includes five modules, namely the context detection module, determinant decision module, Hawk-Dove game module, expectation measurement module, and solution selection module, of the Hawk-Dove game based interaction design mechanism (as depicted in Fig. 2).

4.1   Context Detection Module

The context detection module is designed to realize the environmental situation during service delivery. For instance, the service operations and resources should be carefully considered to optimize service delivery performance and efficacy. The proposed module must recognize customer feedback and behavior, which can be immediately and correctly reposed to the mechanism for further modifying the determinant decision module. Consequently, the learning approach offers a critical and important method via which the mechanism can delivery services in a dynamic context.

4.2   Determinant Decision Module

The determinant decision module collects useful determinants able to effectively influence customer expectations via inputs from the context detection module, customer preferences (such as age, brand interest, price etc.), and encounter database which contains past customer data, delivered service information, and so on. Subsequently, this module automatically analyzes and converts the encounter data, customer preferences and the key performance indicators of the organizer (namely KPIs owing to the exhibition organizer determining the objectives of the whole exhibition) into computable scores to obtain the weight of each determinant. The weight of each determinant indicates the degree of influence on customer expectation within the context. This module selects candidate expectation determinants that can be adopted to influence customer expectations regarding service delivery.

4.3   Hawk-Dove Game Module

This module determines the appropriate expectation determinants to exercise during service encounters. After the determinant decision module obtains the weight of each candidate expectation determinant, the Hawk-Dove game module adopts these determinants as inputs and calculates the appropriate interaction design for use in service delivery. Figure 4 details the procedure of the Hawk-Dove game module. Based on the input data from the determinant decision module and information on the ESS goal database and customer needs, the ESS goal identification component can

define target goals for customer expectations. The Hawk-Dove game for the determinant selection component thus selects determinants appropriate for exercising on customers for customer expectations based on the ESS goal identification component. Finally, these determinants can be incorporated into the solution selection module.
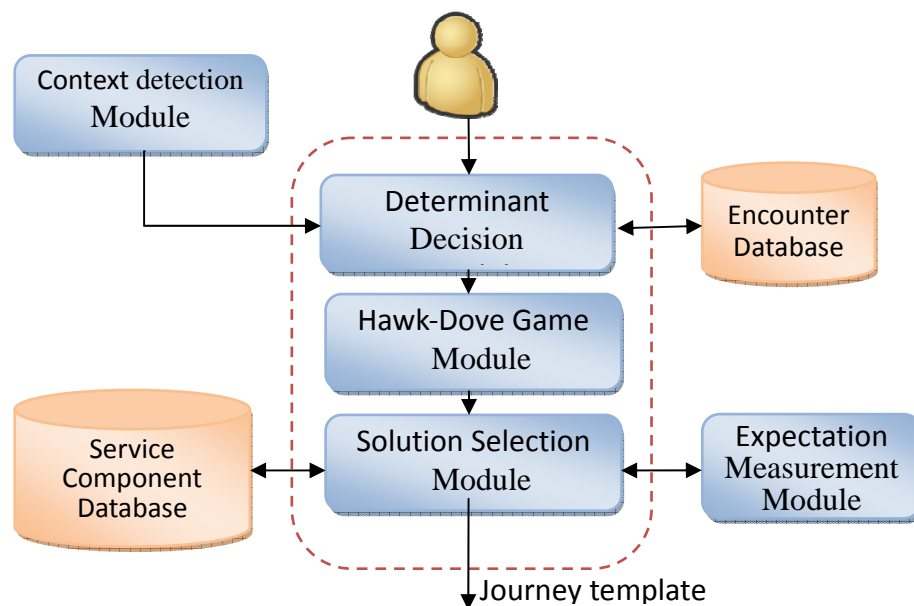

Figure 2. The Design logic

4.4　　　Solution Selection Module

After the Hawk-Dove game module calculates the appropriate determinants to exercise during service delivery, the solution selection module aims to identify the most suitable service components for realizing customer expectation management in the value-bounded context. This confirmation is done by forecasting the effects of the chosen determinants using the expectation measurement module that provides both the scores of the dual expectation measurements and appropriate expectation tactics.

4.5　　　Expectation Measurement Module

This module measures the likely performance of selected determinants obtained using the selection solution module by calculating the customer expectation scores to help the solution selection model choose appropriate service components. Expectation measurement module is a critical function (Hsieh and Yuan, 2009) for realizing customer mental status, and helps ensure the integrity and effectiveness of the Hawk-Dove game based interaction design mechanism. The measure used for expectations is based on a mathematical model based on Fechner's Law (Thurstone, 1929) and operation risk (Basel, 2001). The process of the expectation measurement model, which involves three separate stages, namely: expectation determinants, expectation measurement model and customer expectations. The measurement model also contains feedback which can continuously refresh a real-time database to measure customer expectations.

5　　　EXPERIMENTS AND RESULTS

5.1　　　Experiments related to Customer Expectation Management

The Hawk-Dove game based interaction design mechanism is designed to manage customer expectations regarding the objectives of oligopoly service providers. Since customer expectations vary within dynamic environments, customer stereotypes and their preferences should be considered. This experiment aims to analyze and manage customer expectations to refine the mechanism by clarifying different customer stereotypes and preferences. Accordingly, this experiment verifies

whether the Hawk-Dove game based interaction design mechanism offers a useful means of managing customer expectations and identifying customer stereotypes regarding which mechanism is most effective. Expectation management is designed to help oligopoly service providers lift expectations regarding what is adequate and stabilize the desired expectation. Consequently, the zone of tolerance derived from the desired level narrows accordingly. This experiment applies this mechanism to examine the effects of different customer stereotypes.

Customers / Stereotypes Indicators	Stereotype 1	Stereotype 2	Stereotype 3
Arrival	often	seldom	seldom
Capability	high	medium	low
Effort	medium	much	a little
Request	growth	relation	existence
Subjective preference	medium, low	medium, low	high, medium

Table 2. Three customer stereotypes of variability

Number of experimented customer stereotypes	3
Number of customers in each stereotype	3
Initial adequate expectation measurement value	3.5
Initial desired expectation measurement value	7
Number of service encounters	10
Number of runs	10

Table 3. The parameter settings

Five types of arrival, capability, effort, request, and subjective preference influence customer behavior (Frei, 2006). Table 2 lists different customer stereotypes, including stereotype 1 primarily for self-growing needs with the medium effort, stereotype 2 in which customers expend greater efforts to bargain with the oligopoly service provider, and stereotype 3, which is opposite to the stereotype 1, mainly for ad-hoc existence needs with little effort.

This set of experiments not only employs the above three stereotypes to demonstrate how the Hawk-Dove game based interaction design mechanism handles the management of customer expectation during service encounters, but also compares the measurements of adequate and desired expectations for each customer stereotype. For simplicity, this study assumes that all customers have the same initial score of expectation states (namely 3.5 indicates adequate while 7 indicates desired). The Hawk-Dove game based interaction design mechanism organizes ten service encounters for every customer and applies the appropriate determinants at each encounter (as listed in Table 3). Each experiment employs three users in each stereotype to simulate and record the change in expectations at every encounter over ten runs. The results shown in Fig. 3-4 are then obtained by averaging the variation in expectations of users belonging to the same stereotype.
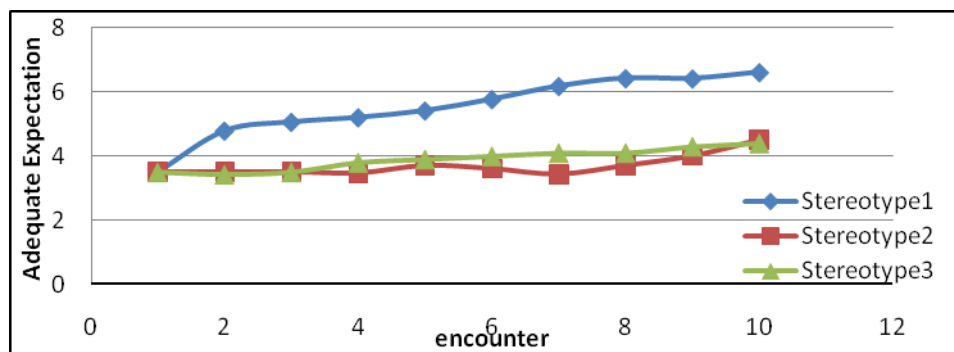

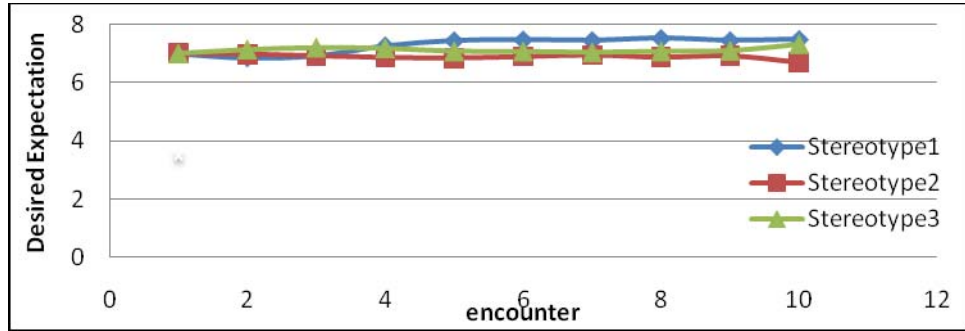*Figure 3. Adequate level of customer expectation*

Figure 4. Desired level of customer expectation

Fig. 3 shows that the trend of adequate expectations regarding stereotype 1 increases with the growth of the encounters. For stereotypes 2 and 3, the trends indicate slight growth via the mechanism. Regarding the stabilization of the desired expectation, Fig. 4 also shows that the mechanism effectively controls customer stereotypes. Moreover, regarding the mechanism goal of lifting the adequate expectation level and stabilizing the desired level, the experiment results indicate that the mechanism has successfully achieved these goals, particularly for stereotype 1.

Stereotype 1 is frequently considered to indicate the target customers of the oligopoly market, who generally have higher capabilities and the domain knowledge necessary to independently select the best service type (Rowley, 1996). Stereotype 1 is also willing to make more effort to become involved in service experience delivery (Rowley, 1996). When stereotype 1 customers lack services choices, this can result in medium or low expectations. These experimental results demonstrate that oligopoly service providers can provide stereotype 1 customers with the opportunity to reflect their needs and become involved in service experience delivery through meticulously designed interactions to manage expectations. The mechanism can adjust the determinants when customer expectations move in the opposite direction or exceed the range. Consequently, the Hawk-Dove game based interaction design mechanism not only provides customers with proper services, but also reliably services customer expectations.

5.2 Experiments for High Performance of the H&D Game based Interaction Design Mechanism

This set of experiments is designed to verify how changes in visitor expectations increase the benefits to all stakeholders (i.e., high performance). This experiment evaluates the overall performance of the Hawk-Dove game based interaction design mechanism from a macro perspective. A high performance ecosystem means all stakeholders (including oligopoly service providers and customers) should maximally benefit from this mechanism. This experiment applies the surplus value theory (Marx, 1952) to examine eco-system performance by evaluating stakeholder value perceptions. The equation of surplus value is as follows:

$$S = P - (C + V)$$

where S denotes surplus value, P represents total value, C is total spending on investments and material, V denotes spending on labor, and (C + V) represents total cost.

Parameter	Definition
S_p	Surplus value of service providers
P_p	The proportion of variation of the zone of tolerance managed after Hawk-Dove game based interaction design mechanism to the original zone of tolerance (z-z')/z
$(C + V)_p$	Providers' participation
S_c	Surplus value of customers
P_c	Real customers' responses
$(C + V)_c$	Customers' participation

Table 4. The definitions of parameters in surplus value

This set of experiments uses pareto optimal to evaluate the performance of the Hawk-Dove game based interaction design mechanism within the ecosystem. In the absence of any feasible solution, an

improvement in one objective does not lead to a simultaneous degradation in one or more of the remaining objectives. A pareto optimal outcome is one such that no-one is made better off without making someone else worse off. Customer services are supposed to be the pareto optimal solution obtained via the Hawk-Dove game based interaction design mechanism based on consideration of various interaction design factors, including profit and cost. The measurement model thus examines the maximum surplus value performance of all stakeholders of the Hawk-Dove game based interaction design mechanism with the following objective function:

$$\textbf{Maximum:}\quad \textbf{\textit{S}}_p = \textbf{\textit{P}}_p - \textbf{\textit{(C + V)}}_p$$
$$\textbf{Maximum:}\quad \textbf{\textit{S}}_c = \textbf{\textit{P}}_c - \textbf{\textit{(C + V)}}_c$$

Table 4 lists the definitions of experiment parameters. The Hawk-Dove interaction design mechanism uses the proportion of zone variation to the original zone to represent P_p, and uses the total cost of implementing the service components during the journey to represent $(C + V)_p$. The mechanism employs the customer satisfaction score for all the service components experienced in the service delivery to represent the P_c. Finally, the mechanism takes the entire time spent in interacting with every service component in service encounters to represent $(C + V)_c$. The experiment uses the Hawk-Dove game based interaction design mechanism to arrange 25 customers. The customer satisfaction score for each encounter minus the customer effort of interacting with the service component can be represented S_c. The proportion of zone variation to the original zone minus the cost of implementing all service components is represented as S_p. The experiments also randomly generate 25 customers that are assigned the values of S_c and S_p. The random scopes and roles are primarily referenced from the domain experts and practical reports. Comparing these two groups of customers with the overall surplus value is to clarify the effect of Hawk-Dove game interaction design mechanism in building a high performance eco-system.
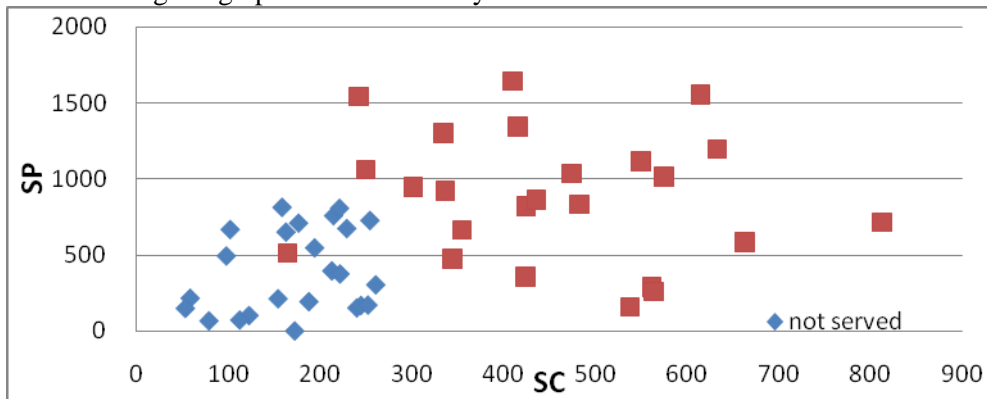

Figure 5. Performances of the proposed mechanism in surplus value

Based on the results of the ecosystem evaluation experiment (as shown in Fig. 5), each point represents a visitor (i.e., the red square represents that the customer is served by the proposed mechanism and the blue rhombus indicates that the customer is randomly assigned the values of S_c and S_p). Except for a single square point, S_c contains no outperforming rhombus point. Moreover, for any pot belonging to the square group, if any pots in the rhombus group have the better performance in S_p, those same pots must have worse-off performance in S_c. To conclude, the simulation results clearly demonstrate that the Hawk-Dove game interaction design mechanism can not only build a good performance ecosystem but can also benefit customers and providers by providing pareto optimality.

6   CONCLUSION

In the experience economy, service providers must design and deliver good customer service based on understanding of customer needs. Service providers can increase customer loyalty to achieve high profits by developing their abilities in experience design (Pullman and Gross, 2004). Interaction design in service experience delivery aims to create functional, purposeful, engaging, compelling, and memorable customer experiences (McLellan, 2000). Moreover, customer involvement can be considered an important means of value co-creation together with service providers. In the oligopoly

market, although service providers play a dominant role, they still need to consider customer satisfaction and develop new services. However, the dilemma that businesses face relates to providing additional services to satisfy customers versus maintaining high profits but risking customer discontent. This predicament becomes serious particularly in oligopoly markets, namely a value bounded context for customers. For resolving the dilemma issue in the oligopoly market, this study presents the Hawk-Dove game interaction design mechanism to increase values between service providers and customers in the value bounded context via customer expectation management and service interaction design. This work not only examines the factors of customer satisfaction and service experience but also establishes a mechanism based on expectation theory and the Hawk-Dove game to deliver a high quality customer experience.

The experimental results generated via the mechanism can also help oligopoly service providers ascertain that good customer expectation management enhances customer satisfaction and profits. Oligopoly service providers can employ only limited resources and consider the context situation to deliver appropriate services and ensure customer satisfaction particularly for stereotype 1 customers using the interface artifact empowered by a measurable and computable modeling of customer psychological expectations. Oligopoly service providers have increased opportunities for customer involvement, enabling customers to contribute to achieve goal value co-creation. Although oligopoly service providers do not need to change their ways and present situations, they can still earn considerable money without the consideration of customer needs and perceptions. Once oligopoly service providers follow the proposed mechanism to achieve an effective and interactive form of service design, they can attract more customers to experience the services and increase their market share, thus boosting profits and eco-system performance.

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