

## Research Article

# Participant and Strategy Selection of Health QR Code Product Experience Design during the COVID-19 Pandemic in China: The Information Security Perspective

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Health QR code is an Internet product designed and developed by China to combat the COVID-19 pandemic. In order to build a public health and epidemic prevention barrier, the Chinese government's health QR code product is a useful attempt to deal with epidemic prevention and control and social governance in the way of "Internet plus big data". In the process of health QR code product design and development, we conduct a security analysis of information data and employ project management, product design, development and testing, online, and operational product experience design methods. User requirements and product definitions for the health QR code include management, design, development, and testing. The main participants of health QR code product experience design are divided into product manager, design and development team, and users. The relationships among the product manager, the design and development team, and users are established using the evolutionary game method. It is found that the cost of information security has an important influence on the choice of the user policy. Product managers, driven by benefits and values, may ignore the importance of information security when choosing the strategy for health QR code products, which will affect users' enthusiasm to use them to some extent and limit their use scenarios and application scope. Therefore, in order to achieve healthy user interaction and sustainable experience design of health QR code products, it is necessary to strengthen data security protection and reduce the cost of information interaction and sharing. Furthermore, on the basis of enhancing user viscosity and improving the usability of health QR code products, our research results show the further need for demand mining and version upgrading of health QR code products.

## 1. Introduction

As an Internet product, the health QR code was designed and developed by China during the fight against the new crown epidemic. China has divided the risk level of new crown disease into three criteria by region. The three criteria are low-risk area, medium-risk area, and high-risk area. Health QR code is based on personal declaration information, travel data, contact personnel information, medical treatment data, identification, data comparison, rules, and other means, to achieve personal epidemic risk level identification and visual display of the "e-health certificate" QR code. Health QR code is everyone's "electronic health certificate" and records the health QR code holder's epidemic

risk level information; epidemic risk level is usually presented in red, yellow, and green. Green code users can travel, yellow code users have restricted travel, and red code users prohibited travel. This is shown in Figure 1.

Under the background that information security is being paid more attention, in the process of product experience design of health QR code product, the definition of group attribute information and interaction behavior data is clearer for product managers and design teams. In the process of product experience design, the work of product experience design should be carried out carefully under the premise of better protection of personal privacy information. In the process of user research, it is necessary to do qualitative research on user requirements and quantitative

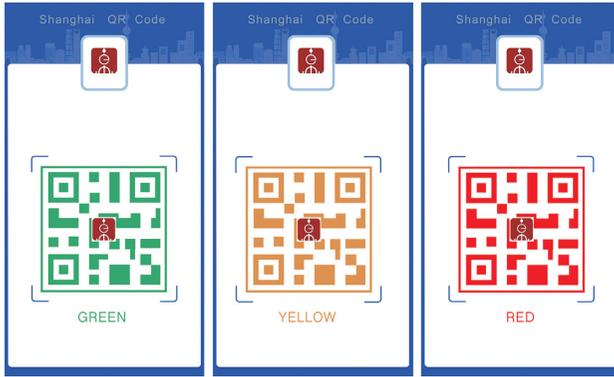


FIGURE 1: User interface for Shanghai health QR code product.

statistics on the priority of requirements. In the process of experience design of information products, it is necessary to utilize data legally and to mine the value of group attribute information and interactive behavior data [1]. With the constant variation of COVID-19, the health QR code information product collects the user's travel information, carries out information exchange in different scenarios, and realizes information exchange and dissemination with health QR code.

## 2. Literature Review

**2.1. Information Product.** Commercial competition of information products in the field of the Internet usually has three main driving forces: business model, technology, and user experience. At a time when there is little difference between the two factors, user experience is the fiercest battleground [2]. The three dimensions of business model, technology, and user are integrated into the process of product design. The role groups represented are product manager, design and development team, and user. Product managers predict the market, competing products, and self-development based on market requirement document (MRD) and product requirement document (PRD), aiming at version iteration and function upgrade of information products, the market, and product requirement documents to the design and development team for product research and development work. Then, MRD and PRD confirm the outline of the information product to serve the target users. Target users are evaluated and give feedback through the use of information products. The product manager develops a new version of the market and product requirement documents based on the use of the target audience, in order to pave the way for the next version of information product design and development, thus forming a closed loop.

Internet information product experience design refers to the research, design, and development of user experience around the information product (APP). The product design process is mainly considered from three aspects: commerce, information technology and users [3]. The role groups represented by the three aspects are product manager, design and development team, and target users. The product manager combs and summarizes the market requirement document

(MRD) and product requirement document (PRD). The product manager carries out version iterations for information products and forecasts the future development of the market, competitive products, and their own products. Based on the market and product requirement document, the design and development team carries out product function development, promotes the iterative launch of information products, meets the needs of target users, and expands the target user group. After using the information products, the target user group will evaluate and give feedback. By investigating the use intention of the target user group, the product manager forms an iterative version of the market and product requirements document, which lays a foundation for the design and development of the new version of information products. Through the interaction of the three groups, the iterative upgrading of information products is formed. Information product design and development is an iterative process.

**2.2. User Experience.** Experience design has a lot to do with user experience. ISO 9241-210:2019 defines user experience as "people's cognitive impressions and responses to the products, systems, or services they use or expect to use". User's perceptions and responses result from the use and anticipated use of a system, product, or service [4]. Experience design is the participation of consumers in the design, in the design of the service as a "stage", the product as a "prop", and the environment as a "set". Designing for the users' experience involves considering, where appropriate, organizational impacts, user documentation, online help, support and maintenance, training, long-term use, and product packaging [5].

**2.3. Product Experience Design.** The related research of product experience design began in Europe and developed in America. It can be divided into four stages:

- (1) The Industrial Revolution gave birth to human-computer interaction: the study of Ergonomics, which originated in the World War II era as the study of the control interface of military equipment, was designed to evolve from "useful" to "efficient", by American industrial designer Henry Dreves [6].
- (2) Human-centered interaction design: with the development of Ergonomics, the focus of attention had shifted from machine to human, and "interaction design" has been emphasized. In 1995, Alan Cooper, a software engineer, began to systematically expound the design principles of human-computer interaction [7]. Then, the "user experience design" and "user-centered design" concept proposed by Harvard University Donald Norman (Don Norman) formed the user experience design trend of the future [8]. Then, in 1999, Elizabeth Sandl of Ohio State University came up with a "design for experience" [9]. California Institute of the Arts Sedov first linked experience to design in a 2001 monograph, thinking about experience in a design context [10].
- (3) "Emotional Design" of information industry: Norman delved into how to incorporate emotional

effects into product design from three dimensions: instinct, behavior, and reflection (2003); in “systems and services”, the author discussed “design for experience” to realize the further development from user experience to experience design (2011) [11].

- (4) Experience Design in the age of smart media. Richard put forward the concepts of design management and design business [12]. In the industrial community, with the introduction of the iPhone in 2007, the launch of Google’s Android operating system in 2009, and the launch of the iPad in 2010, bringing the evolution of experience design to the Fast Lane of the Mobile Smart Internet, the iOS operating system design specification, released in 2010, is a design guide for experience design.

**2.4. Agile Development and Design Sprint.** In software development, agile (sometimes written agile development) [13] practices involve discovering requirements and developing solutions through the collaborative effort of self-organizing and cross-functional teams and their customers and users [14]. It advocates adaptive planning, evolutionary development, early delivery, and continual improvement, and it encourages flexible responses to change.

Agile development takes the evolution of user’s requirements as the core and adopts an iterative and step-by-step method to develop software. In agile development, software projects are split into subprojects early in their construction, and the results of each subproject are tested and characterized by visibility, integration, and usability. In other words, a large project is broken up into small, interconnected projects that can run independently and this is done separately, all the while keeping the software usable.

The design sprint is a time-constrained, five-phase process that uses design thinking with the aim of reducing the risk when bringing a new product, service, or feature to the market [15]. The process aims to help teams clearly define goals, validating assumptions and deciding on a product road map before starting development [16]. It seeks to address strategic issues using interdisciplinary, rapid prototyping, and usability testing. This design process is similar to Sprints in an agile development cycle [17].

Design Sprint is a combination of design thinking and agile development of two design methods, through team building, targeting, incubating ideas, incubating prototypes, and rapid verification of the design process; it is a short-term and rapid development method for a known problem that needs to be solved [18].

**2.5. Evolutionary Game Theory.** Game Theory originated from the book *Theory Games and Economic Behavior* written by John von Neumann and Oskar Morgenstern in 1944, which laid the Theoretical and Methodological Foundation of Game Theory. In 1965, Reinhard Selten introduced the concept of Nash Equilibrium into the analysis of dynamic problems and put forward the famous concept of “subgame-perfect equilibrium”. John Harsanyi then introduced incomplete

information into Game Theory and proposed the concepts of the incomplete game and Bayes equilibrium, as well as the methods to deal with the incomplete information game. In the 1990s, Friedman explored Evolutionary Game Theory and research methods in the field of economics [19]. A three-way evolutionary game model is built around product managers, design and development teams, and users, focusing on the impact of business model value performance and usability evaluation of the target user group on the experience design process of information products; as a key group of information product development, the design and development team is, in essence, the transfer process of knowledge related to information products, most of which are tacit knowledge with exclusive characteristics; it is often seen as a personal asset and a guarantee of job security in an organization [20]. Therefore, in the process of experience design of information product requirements, the product manager may not have enough time or high quality for the design and development team according to the requirements of the market and the target user group; this possibility has led to the emergence of a game among three participants in the experience design process of information products. And this game is also a repeated process because information product requirement development cannot be completed at one time; it usually needs to be repeated many times [21]. Evolutionary game is introduced to study the interaction mechanism and participation strategy selection of main stakeholders in Internet information product design based on bounded rationality [22].

### 3. The Evolutionary Game Model

**3.1. Model Description.** During an epidemic of COVID-19, the health QR code is an Internet information product of public health and antiepidemic service. Health QR code product’s original intention comes from the user’s demand. It can quickly adjust and reflect the product design level, implement product iteration update, in order to better retain users, improve the user experience, and then form a closed loop of user growth. In the era of big data, user data analysis is an important prerequisite for mining user needs, and the collection and mining of user personal data will accelerate the risk of personal information leakage. Based on this, this paper constructs an evolutionary game model of stakeholders in the iterative design process of health QR code products, considering the influence of user information security; the relationship between the players is shown in Figure 2.

As shown in Figure 2, the health QR code product iteration involves three main stakeholders: product manager, design and development team, and user. By analyzing the user data, the product manager forms the MRD and PRD and forecasts the market, competition, and self-development of the information product based on MRD and PRD. Subsequently, the product manager will market product requirement documents to the design and developmental team, by which the corresponding research and development work, finally, is delivered as an online service to users. The product manager forms a new version of the market and product requirement document through the user’s feedback to the information product, which paves the way for the

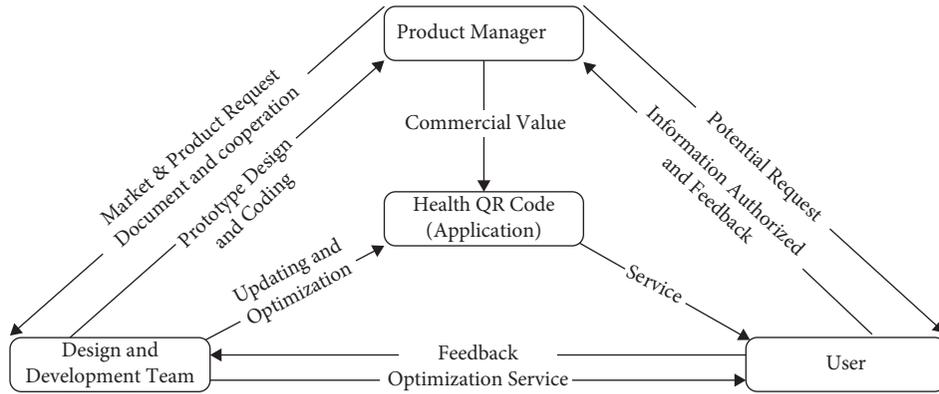


FIGURE 2: Tripartite game diagram.

design and development of the next version of the information product, thus forming a closed loop. Product managers and design and development teams work together through product iterations to provide users with an increasing sense of experience, to enhance user stickiness, to meet the needs of users while achieving the common goal of fighting the epidemic. As the final service object of the product, the feedback of user experience plays an important role in the iterative updating of information products.

In the era of big data, data has become an important resource. From a business perspective, the collection and utilization of user's personal data can help product managers to discover new user needs and provide better service for users, but it will also increase the risk of user data leakage; once the user's private information is divulged, it will have a seriously bad influence on the user and the information product, so this paper considers the influence of the user's data security on the product experience design. As mentioned above, the product manager acts as a bridge between the client's side and the product of health QR code design side in experience design and development of the health QR code product. The product manager will discover the user requirements of the design and development team, to achieve functional development and service upgrades. However, in the process of forming MRD and PRD, product managers may generate different oriented MRD and PRD based on two different starting points: benefit and experience. At the same time, with the development of technology, information product development has gradually changed from the traditional function-oriented and technology-oriented to user experience-oriented. As a result, product managers and design teams have two different approaches toward information product development, one based on performance and the other based on experience. One of the contributions of this paper is to explore the interactive mechanism of the stakeholders in the design process of health QR code as an information product, analyze how to promote product managers and design and development teams to transform into user experience-oriented development philosophy, provide better service for users, and extend the life cycle of health QR code information products.

**3.2. Model Assumptions.** Based on the description in Section 3.1 and the tripartite game diagram, the following hypotheses are proposed.

*Hypothesis 1.* This study assumes that stakeholders in the process of experience design of the health QR code are product managers, design and development teams, and user groups [23]. Experienced design and development of the health QR code is not quickly achieved, in which stakeholders need to learn, try mistakes, imitate the behavior of others, constantly adjust and modify personal behavior strategy, and then achieve a stable equilibrium [24].

*Hypothesis 2.* Product managers and design and development teams assume different strategies based on two different starting points: efficiency and experience. Therefore, the strategic space for setting the product manager group is {experience-oriented, benefit-oriented}, The proportion of choosing a benefit-oriented strategy is  $x$  ( $0 \leq x \leq 1$ ), the design and development team's strategy space is {experience design, agile development and design sprint}, and the percentage that chooses an experience design strategy is  $y$  ( $0 \leq y \leq 1$ ). Users can choose to license their private data to information products for better service, or they can choose not to license their private data to apps for data security reasons. Therefore, the policy space for the user community is set to {Authorized information sharing, not authorized information sharing}, where the percentage of authorization policies selected is  $z$  ( $0 \leq z \leq 1$ ). The health QR code products studied in this paper are products that already have a certain scale of users, so the experience design and development process is mainly embodied in product version iteration, optimization, and new function development, etc., where the user has authorized the product to collect its basic information. Therefore, the article sets authorized information sharing as a higher level of information sharing and may involve some personal privacy information. It should be noted that in reality, the function of product manager includes but is not limited to the function described in this paper. In addition, this paper also assumes that the experience/benefit-oriented needs of the product manager have an important embodiment of the user-centered/product-centered work philosophy of the product manager.

*Hypothesis 3.* If the user is authorized to share personal information in the process of using the product, the user can get the best user experience after the experience-oriented design upgrade; the benefit is  $R_{u1}$ ; when the product manager and the design and development team do not choose the same strategy, that is, only one side chooses the user experience-oriented strategy, which is the focus of the study, the payoffs are all  $R_{u2}$ . After the product's performance-oriented and agile development upgrade, user revenue was  $R_{u3}$ . According to the degree of product experience design, the user benefits after product upgrade under the authorized information sharing strategy  $R_{u1} > R_{u2} > R_{u3}$ . At the same time, the collection and mining of user's personal data will accelerate the risk of personal information leakage [24]. As a result, authorized sharing of user information can result in additional potential losses  $C_u$  such as privacy breaches. If users are not authorized to share information in the process of use, because the product manager cannot accurately explore their needs, so different types of product upgrades to its revenue are less than the same situation authorized to share information users' revenue, that is  $R_{u1} > R'_{u1}$ ,  $R_{u2} > R'_{u2}$ , and  $R_{u3} > R'_{u3}$ . In addition, the effect of the degree of product experience design on user revenue is also valid under the unauthorized information sharing policy; that is to say,  $R'_{u1} > R'_{u2} > R'_{u3}$  is valid.

*Hypothesis 4.* When the user chooses the authorized information sharing strategy in the process of using the product, the product manager can precisely discover more user requirements and improve user stickiness. Therefore, this paper assumes that user-authorized information sharing strategy will increase the revenue of product managers with different demand-oriented strategies; that is, there is a revenue coefficient of  $\beta$  ( $\beta > 1$ ); when the user shares the authorized information, the revenue of the product manager's choice of experience-oriented demand is  $\beta R_{m1}$ , the revenue of the benefit-oriented demand is  $\beta R'_{m1}$ , and  $R_{m1}$  and  $R'_{m1}$  are the revenue of the product manager under the above two strategies when the user does not authorize information sharing. Product managers also face the potential loss (reputation, etc.)  $L_m$  of user privacy due to the higher level of information sharing and the adverse impact of information disclosure. It should be noted that regardless of whether the user chooses to authorize information sharing, the cost for product managers to propose experience-oriented requirements is  $C_{m1}$ , and the cost for benefit-oriented requirements is  $C'_{m1}$ . The introduction of experience-oriented requirements improves the user experience, as does the cost to the product manager, so there are  $C_{m1} > C'_{m1}$ . At the same time, when the product manager proposes the experience-oriented requirement, if the design and development team focus on the experience design, the two sides will bring the additional synergy benefit  $\Delta R_{m1}$ . When a product manager brings forward a benefit-oriented requirement, an experience design by the design and development team will bring additional revenue to the product manager  $\Delta R'_{m1}$ . Furthermore, regardless of the strategy chosen by the product manager, coordination costs arise when design development teams conflict with the product manager's design philosophy  $C_{m2}$ .

*Hypothesis 5.* When users authorize information sharing, the design and development team can obtain more additional information and user feedback, more specifically meet the needs put forward by the product manager, solve the user pain points, and reduce the design and development cost. Therefore, this paper assumes that user authorized information sharing can effectively reduce the difficulty of development and design, that is, there is a cost coefficient  $\delta$  ( $0 < \delta < 1$ ), so that the design and development cost can be reduced when user authorized information sharing. At this time, the costs paid by team experience design and agile development (including the additional costs paid for properly storing user information) are  $\delta C_{d1}$  and  $\delta C'_{d1}$  respectively, where  $C_{d1}$  and  $C'_{d1}$  are the cost of experience design and agile development strategy selected by the design and development team when the user does not authorize information sharing. No matter whether the user authorizes information sharing or not, the benefit obtained by the design team from experience design is  $R_{d1}$ , and the benefit obtained from agile development is  $R'_{d1}$ , which is obviously  $R_{d1} > R'_{d1} > C'_{d1} > C_{d1}$ . When users authorize information sharing, no matter what strategy the design and development team chooses, the design and development team will face potential losses  $L_d$  (reputation, etc.) caused by user privacy data disclosure. As stated in Hypothesis 4, if both the design and development team and the product manager carry out user experience-oriented product design, additional synergy benefits will be generated, which is  $\Delta R_{m1}$ , but when their design concepts conflict, the performance loss to the design and development team will be  $C_{d2}$ .

Thus, relevant symbols and meaning descriptions of the Internet product experience design strategy selection model are shown in Table 1.

As mentioned earlier, the user can choose whether to authorize information, and the product manager can choose experience-oriented or benefit-oriented information product design and development strategies. The design and development team can adopt the product experience design method or agile development and design sprint method to obtain different income orientations under different strategies. The tripartite game tree formed by the three parties is shown in Figure 3.

## 4. The Analysis of Multiagent Evolutionary Game Model

*4.1. Establishment of Multiagent Evolutionary Game Model.* Based on the game diagram of product manager, design and development team, and users and the above basic assumptions, the payment matrix of user's choice of authorized information sharing strategy and unauthorized information sharing strategy for health QR code product experience design is obtained, as shown in Tables 2 and 3.

Based on the above payment matrix, the expected returns  $U_{m1}$  for the experience-oriented strategy,  $U_{m2}$  for the benefit-oriented strategy, and  $U_m$  for the group of product managers are

TABLE 1: The symbols and meaning description.

Symbols	Meaning description
$x$	The probability that the product manager selects the experience-oriented strategy; then $1 - x$ is the probability of selecting the benefit-oriented strategy ( $0 \leq x \leq 1$ )
$y$	The probability that the design and development team carries out experience design; then $1 - y$ is the probability of agile development and design sprint ( $0 \leq y \leq 1$ )
$z$	If the user selects the probability of authorizing information sharing, then $1 - z$ is the probability of not authorizing information sharing ( $0 \leq z \leq 1$ )
$R_{u1}$	Experience-oriented in the case of authorized information sharing & the benefits of users after the upgrade of experience design
$R_{u2}$	In the case of authorized information sharing, only one party chooses to be user-experience-oriented. The benefits of users after product upgrading
$R_{u3}$	Benefit orientation of products in the case of authorized information sharing & benefits of users after agile development and upgrading
$C_u$	Authorized information sharing will bring potential extra losses to users, such as privacy disclosure
$R'_{u1}$	Experience-oriented in the case of unauthorized information sharing & the benefits of users after the upgrade of experience design
$R'_{u2}$	In the case of unauthorized information sharing, only one party chooses to be user-experience-oriented. The benefits of users after product upgrading
$R'_{u3}$	Benefit orientation of products without authorized information sharing & benefits of users after agile development and upgrading
$\beta$	Revenue promotion coefficient of authorized information sharing for product managers ( $\beta > 1$ )
$R_{m1}$	Revenue generated when product managers choose experience-oriented needs without authorizing information sharing
$R'_{m1}$	Revenue generated when the product manager selects benefit-oriented demand without authorizing information sharing
$L_m$	Potential loss (reputation, etc.) to the product manager due to the risk of user privacy data disclosure under authorized information sharing
$C_{m1}$	The product manager chooses to propose the cost of experience-oriented demand
$C'_{m1}$	The product manager chooses to propose the cost of benefit-oriented demand
$\Delta R_{m1}$	The product manager puts forward experience-oriented requirements and the design and development team carries out experience design, which brings synergy benefits to both parties
$\Delta R'_{m1}$	The product manager puts forward benefit-oriented requirements, and the design and development team carries out experience design, which brings additional benefits to the product manager
$C_{m2}$	Coordination cost of product manager when the design and development team conflicts with the design concept of product manager
$\delta$	Cost reduction factor of authorized information sharing for design and development team ( $0 < \delta < 1$ )
$C_{d1}$	Cost of experience design strategy selected by design and development team without authorization of information sharing
$C'_{d1}$	Cost of design and development team choosing agile development and design sprint strategy without authorized information sharing
$R_{d1}$	Benefits of experience design by design and development team
$R'_{d1}$	Benefits of agile development and design sprint by design and development team
$L_d$	Potential loss to the design and development team due to the risk of user privacy data disclosure in the case of authorized information sharing
$C_{d2}$	The performance loss caused by the conflict with the design concept of the product manager to the design and development team

$$\begin{aligned}
U_{m1} &= yz(\beta R_{m1} - C_{m1} + \Delta R_{m1} - L_m) + y(1 - z)(R_{m1} - C_{m1} + \Delta R_{m1}) \\
&\quad + (1 - y)z(\beta R_{m1} - C_{m1} - C_{m2} - L_m) + (1 - y)(1 - z)(R_{m1} - C_{m1} - C_{m2}) \\
&= R_{m1} - C_{m1} - C_{m2} + y(\Delta R_{m1} + C_{m2}) + z[(\beta - 1)R_{m1} - L_m],
\end{aligned} \tag{1}$$

$$\begin{aligned}
U_{m2} &= yz(\beta R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2} - L_m) + y(1 - z)(R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2}) \\
&\quad + (1 - y)z(\beta R'_{m1} - C'_{m1} - L_m) + (1 - y)(1 - z)(R'_{m1} - C'_{m1}) \\
&= R'_{m1} - C'_{m1} + y(\Delta R'_{m1} - C_{m2}) + z[(\beta - 1)R'_{m1} - L_m],
\end{aligned} \tag{2}$$

$$U_m = xU_{m1} + (1 - x)U_{m2}. \tag{3}$$

The design team's expected payoff for choosing an experience design strategy  $U_{d1}$ , the design team's expected

payoff for choosing agile development and design sprint strategy  $U_{d2}$ , and the design team's expected payoff  $U_d$  are

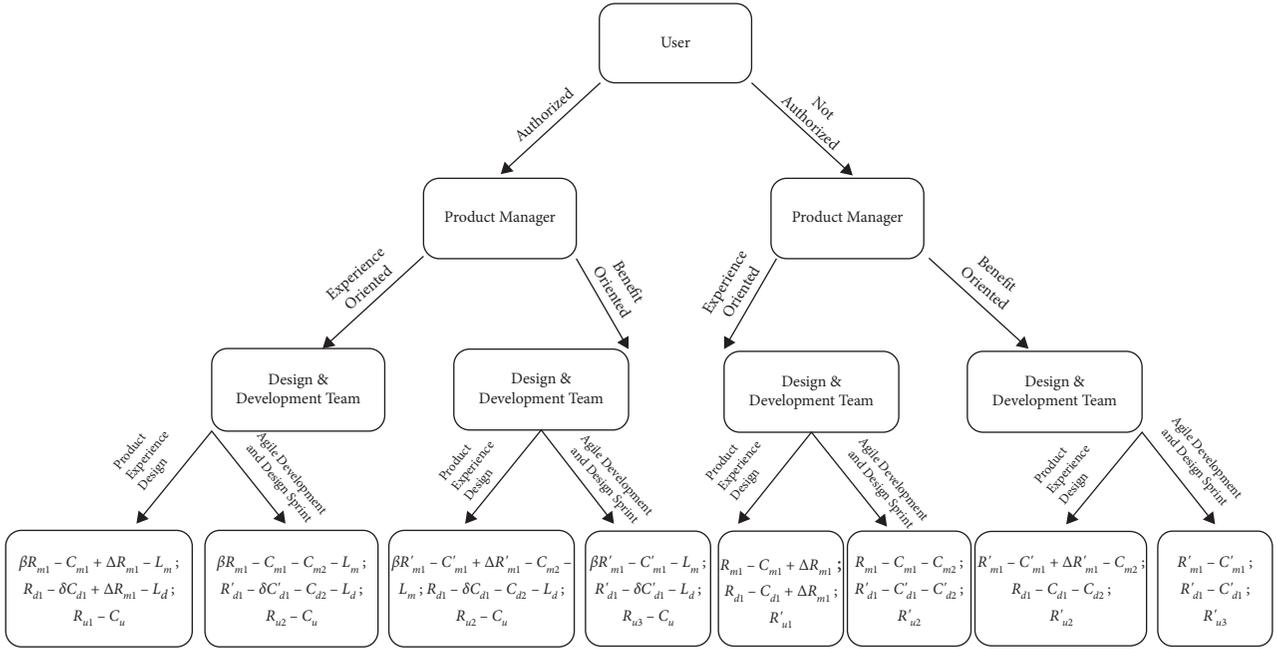


FIGURE 3: The tripartite game tree.

TABLE 2: Payment matrix under user-selected authorization information sharing policy ( $z$ ).

Product manager	Design and development team	
	Product experience design ( $y$ )	Agile development and design sprint ( $1 - y$ )
Experience orientation ( $x$ )	$(\beta R_{m1} - C_{m1} + \Delta R_{m1} - L_m; R_{d1} - \delta C_{d1} + \Delta R_{m1} - L_d; R_{u1} - C_u)$	$(\beta R_{m1} - C_{m1} - C_{m2} - L_m; R'_{d1} - \delta C'_{d1} - C_{d2} - L_d; R_{u2} - C_u)$
Benefit orientation ( $1 - x$ )	$(\beta R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2} - L_m; R_{d1} - \delta C_{d1} - C_{d2} - L_d; R_{u2} - C_u)$	$(\beta R'_{m1} - C'_{m1} - L_m; R'_{d1} - \delta C'_{d1} - L_d; R_{u3} - C_u)$

TABLE 3: Payment matrix under user-selected unauthorized information sharing policy ( $1 - z$ ).

Product manager	Design and development team	
	Product experience design ( $y$ )	Agile development and design sprint ( $1 - y$ )
Experience orientation ( $x$ )	$(R_{m1} - C_{m1} + \Delta R_{m1}; R_{d1} - C_{d1} + \Delta R_{m1}; R'_{u1})$	$(R_{m1} - C_{m1} - C_{m2}; R'_{d1} - C'_{d1} - C_{d2}; R'_{u2})$
Benefit orientation ( $1 - x$ )	$(R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2}; R_{d1} - C_{d1} - C_{d2}; R'_{u2})$	$(R'_{m1} - C'_{m1}; R_{d1} - C_{d1}; R'_{u3})$

$$\begin{aligned}
 U_{d1} &= xz(R_{d1} - \delta C_{d1} + \Delta R_{m1} - L_d) + x(1 - z)(R_{d1} - C_{d1} + \Delta R_{m1}) \\
 &\quad + (1 - x)z(R_{d1} - \delta C_{d1} - C_{d2} - L_d) + (1 - x)(1 - z)(R_{d1} - C_{d1} - C_{d2}) \\
 &= R_{d1} - C_{d1} - C_{d2} + x(\Delta R_{m1} + C_{d2}) + z[(1 - \delta)C_{d1} - L_d],
 \end{aligned} \tag{4}$$

$$\begin{aligned}
 U_{d2} &= xz(R'_{d1} - \delta C'_{d1} - C_{d2} - L_d) + x(1 - z)(R'_{d1} - C'_{d1} - C_{d2}) \\
 &\quad + (1 - x)z(R'_{d1} - \delta C'_{d1} - L_d) + (1 - x)(1 - z)(R'_{d1} - C'_{d1}) \\
 &= R'_{d1} - C'_{d1} - xC_{d2} + z[(1 - \delta)C'_{d1} - L_d],
 \end{aligned} \tag{5}$$

$$U_d = yU_{d1} + (1 - y)U_{d2}. \tag{6}$$

The expected revenue of users choosing authorized information sharing strategy  $U_{u1}$ , the expected revenue of

users choosing nonauthorized information sharing strategy  $U_{u2}$ , and the expected revenue of users group  $U_u$  are

$$U_{u1} = xy(R_{u1} - C_u) + x(1-y)(R_{u2} - C_u) + (1-x)y(R_{u2} - C_u) + (1-x)(1-y)(R_{u3} - C_u) \quad (7)$$

$$= R_{u3} - C_u + x(R_{u2} - R_{u3} + yR_{u1} - yR_{u2}) + (1-x)y(R_{u2} - R_{u3}),$$

$$U_{u2} = xyR'_{u1} + x(1-y)R'_{u2} + (1-x)yR'_{u2} + (1-x)(1-y)R'_{u3} \quad (8)$$

$$= R'_{u3} + x(R'_{u2} - R'_{u3} + yR'_{u1} - yR'_{u2}) + (1-x)y(R'_{u2} - R'_{u3}),$$

$$U_u = zU_{u1} + (1-z)U_{u2}. \quad (9)$$

According to the copy dynamic equation method of the evolutionary game, the copy dynamic equation of the

demand-oriented strategy choice of the product manager is obtained by the combination of (1) and (2):

$$F_m(x) = \frac{dx}{dt} = x(1-x)[R_{m1} - C_{m1} - C_{m2} - R'_{m1} + C'_{m1} + y(\Delta R_{m1} - \Delta R'_{m1} + 2C_{m2}) + z(\beta - 1)(R_{m1} - R'_{m1})]. \quad (10)$$

By the same token, the replication dynamic equations for the Design Development Strategy Selection and the user information authorization strategy selection are as follows:

$$F_d(y) = \frac{dy}{dt} = y(1-y)[R_{d1} - C_{d1} - C_{d2} - R'_{d1} + C'_{d1} + x(\Delta R_{m1} + 2C_{d2}) + z(1-\delta)(C_{d1} - C'_{d1})], \quad (11)$$

$$F_u(z) = \frac{dz}{dt} = z(1-z)[R_{u3} - C_u - R'_{u3} + x(R_{u2} - R_{u3} - R'_{u2} + R'_{u3}) + xy(R_{u1} - R_{u2} - R'_{u1} + R'_{u2}) + (1-x)y(R_{u2} - R_{u3} - R'_{u2} + R'_{u3})]. \quad (12)$$

**4.2. Stability Analysis of Evolutionary Game.** In order to explore the stability strategy of system evolution and the corresponding conditions, (4), (8), and (12) are used

simultaneously to obtain the dynamic system composed of product manager, design and development team, and users as follows:

$$\begin{cases} F_m(x) = x(1-x)[R_{m1} - C_{m1} - C_{m2} - R'_{m1} + C'_{m1} + y(\Delta R_{m1} - \Delta R'_{m1} + 2C_{m2}) + z(\beta - 1)(R_{m1} - R'_{m1})], \\ F_d(y) = y(1-y)[R_{d1} - C_{d1} - C_{d2} - R'_{d1} + C'_{d1} + x(\Delta R_{m1} + 2C_{d2}) + z(1-\delta)(C_{d1} - C'_{d1})], \\ F_u(z) = z(1-z)[R_{u3} - C_u - R'_{u3} + x(R_{u2} - R_{u3} - R'_{u2} + R'_{u3}) + xy(R_{u1} - R_{u2} - R'_{u1} + R'_{u2}) + (1-x)y(R_{u2} - R_{u3} - R'_{u2} + R'_{u3})]. \end{cases} \quad (13)$$

Based on (13), we can obtain eight pure strategy local equilibria  $E_1(0, 0, 0)$ ,  $E_2(1, 0, 0)$ ,  $E_3(0, 1, 0)$ ,  $E_4(0, 0, 1)$ ,

$E_5(1, 1, 0)$ ,  $E_6(1, 0, 1)$ ,  $E_7(0, 1, 1)$ , and  $E_8(1, 1, 1)$  and one mixed strategy local stability point  $E_9(x^*, y^*, z^*)$  where

$$\begin{cases} x^* = \frac{R'_{d1} - C'_{d1} - R_{d1} + C_{d1} + C_{d2} - z^*(1 - \delta)(C_{d1} - C'_{d1})}{\Delta R_{m1} + 2C_{d2}}, \\ y^* = \frac{R'_{u3} - R_{u3} + C_u - x^*(R_{u2} - R_{u3} - R'_{u2} + R'_{u3})}{x^*R_{u1} - x^*R'_{u1} + (1 - 2x^*)R_{u2} - (1 - x^*)R_{u3} - (1 - 2x^*)R'_{u2} + (1 - x^*)R'_{u3}}, \\ z^* = \frac{R'_{m1} - C'_{m1} - R_{m1} + C_{m1} + C_{m2} - y^*(\Delta R_{m1} - \Delta R'_{m1} + 2C_{m2})}{(\beta - 1)(R_{m1} - R'_{m1})}. \end{cases} \quad (14)$$

It is important to note that  $E_9(x^*, y^*, z^*)$  can only become evolutionarily stable if and only if  $0 \leq x^*, y^*, z^* \leq 1$  occurs.

The study of Wei et al. [25] shows that we only need to analyze the stability of the above 8 pure strategy equilibrium points when we analyze the three-party evolutionary game. Friedman [19] proposed that the local stability of the equilibrium point can be analyzed by the Jacobi Matrix. According to the judgment method of evolutionarily stable strategy, this strategy is evolutionarily stable strategy. Therefore, draw on previous research methods for the following analysis. Based on (13), the Jacobi Matrix of the system is

$$J = \begin{bmatrix} \frac{\partial F_m(x)}{\partial x} & \frac{\partial F_m(x)}{\partial y} & \frac{\partial F_m(x)}{\partial z} \\ \frac{\partial F_d(y)}{\partial x} & \frac{\partial F_d(y)}{\partial y} & \frac{\partial F_d(y)}{\partial z} \\ \frac{\partial F_u(z)}{\partial x} & \frac{\partial F_u(z)}{\partial y} & \frac{\partial F_u(z)}{\partial z} \end{bmatrix} = \begin{bmatrix} J_{11} & J_{12} & J_{13} \\ J_{21} & J_{22} & J_{23} \\ J_{31} & J_{32} & J_{33} \end{bmatrix}. \quad (15)$$

Among them,

$$\begin{aligned} J_{11} &= (1 - 2x)[R_{m1} - C_{m1} - C_{m2} - R'_{m1} + C'_{m1} + y(\Delta R_{m1} - \Delta R'_{m1} + 2C_{m2}) + z(\beta - 1)(R_{m1} - R'_{m1})], \\ J_{12} &= x(1 - x)(\Delta R_{m1} - \Delta R'_{m1} + 2C_{m2}), \\ J_{13} &= x(1 - x)(\beta - 1)(R_{m1} - R'_{m1}), \\ J_{21} &= y(1 - y)(\Delta R_{m1} + 2C_{d2}), \\ J_{22} &= (1 - 2y)[R_{d1} - C_{d1} - C_{d2} - R'_{d1} + C'_{d1} + x(\Delta R_{m1} + 2C_{d2}) + z(1 - \delta)(C_{d1} - C'_{d1})], \\ J_{23} &= y(1 - y)(1 - \delta)(C_{d1} - C'_{d1}), \\ J_{31} &= z(1 - z)[R_{u2} - R_{u3} - R'_{u2} + R'_{u3} + y(R_{u1} - 2R_{u2} + R_{u3} - R'_{u1} + 2R'_{u2} - R'_{u3})], \\ J_{32} &= z(1 - z)[x(R_{u1} - R_{u2} - R'_{u1} + R'_{u2}) + (1 - x)(R_{u2} - R_{u3} - R'_{u2} + R'_{u3})], \\ J_{33} &= (1 - 2z)[R_{u3} - C_u - R'_{u3} + x(R_{u2} - R_{u3} - R'_{u2} + R'_{u3}) + xy(R_{u1} - R_{u2} - R'_{u1} + R'_{u2}) + (1 - x)y(R_{u2} - R_{u3} - R'_{u2} + R'_{u3})]. \end{aligned} \quad (16)$$

Based on the research ideas of Fang et al. [26], the evolutionary stability analysis of the above 8 pure strategy equilibrium points was conducted.

(1) The eigenvalue of the Jacobi matrix at  $E_1(0, 0, 0)$  is

$$\begin{cases} \lambda_1^{E_1} = R_{m1} - C_{m1} - C_{m2} - R'_{m1} + C'_{m1}, \\ \lambda_2^{E_1} = R_{d1} - C_{d1} - C_{d2} - R'_{d1} + C'_{d1}, \\ \lambda_3^{E_1} = R_{u3} - C_u - R'_{u3}, \end{cases} \quad (17)$$

when  $\lambda_1^{E_1}, \lambda_2^{E_1}$ , and  $\lambda_3^{E_1}$  are all less than 0,  $E_1(0, 0, 0)$  will become the evolutionarily stable strategy. The product manager and the design development team choose the benefit-oriented strategy in the iterative design and development of the health QR code

product, and the user is not authorized to share personal information.

(2) The eigenvalue of the Jacobi matrix at the equilibrium point  $E_2(1, 0, 0)$  is

$$\begin{cases} \lambda_1^{E_2} = -(R_{m1} - C_{m1} - C_{m2} - R'_{m1} + C'_{m1}) = -\lambda_1^{E_1}, \\ \lambda_2^{E_2} = R_{d1} - C_{d1} - R'_{d1} + C'_{d1} + \Delta R_{m1} + C_{d2}, \\ \lambda_3^{E_2} = R_{u2} - C_u - R'_{u2}. \end{cases} \quad (18)$$

According to (18),  $\lambda_1^{E_2} = -\lambda_1^{E_1}$ . Therefore,  $E_2(1, 0, 0)$  and  $E_1(0, 0, 0)$  cannot be evolutionarily stable strategies at the same time. When  $R'_{m1} - C'_{m1} < R_{m1} - C_{m1} - C_{m2}$ ,  $R_{d1} - C_{d1} + \Delta R_{m1} < R'_{d1} - C'_{d1} - C_{d2}$ , and  $R_{u2} - C_u < R'_{u2}$ ,  $E_2(1, 0, 0)$  will become the

evolutionarily stable strategy. This means that even if the user chooses not to authorize information sharing, and the design team chooses agile for technical and cost reasons, when the product manager deducts the coordination cost of the design team's inconsistent development thinking; when the net income of experience-oriented demand is higher than that of benefit-oriented demand, the product managers will still choose the experience-oriented strategy; that is, the design and development demand based on user experience is proposed.

(3) The eigenvalue of the Jacobi matrix at  $E_3(0, 1, 0)$  is

$$\begin{cases} \lambda_1^{E_3} = R_{m1} - C_{m1} + \Delta R_{m1} - R'_{m1} + C'_{m1} - \Delta R'_{m1} + C_{m2}, \\ \lambda_2^{E_3} = -(R_{d1} - C_{d1} - C_{d2} - R'_{d1} + C'_{d1}) = -\lambda_2^{E_1}, \\ \lambda_3^{E_3} = R_{u2} - C_u - R'_{u2}. \end{cases} \quad (19)$$

Based on (19), both  $E_3(0, 1, 0)$  and  $E_1(0, 0, 0)$  cannot be evolutionarily stable strategies. If  $R_{m1} - C_{m1} + \Delta R_{m1} < R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2}$ ,  $R_{d1} - C_{d1} - C_{d2} > R'_{d1} - C'_{d1}$ , and  $R_{u2} - C_u < R'_{u2}$  meet simultaneously,  $E_3(0, 1, 0)$  is the evolutionarily stable strategy of the system. At this point, the net income of the product manager choosing an experience-oriented strategy is lower than that of the benefit orientation strategy, and the net income of the design and development team choosing experience design strategy is higher than that of agile development and design sprint strategy. For users, even if the design and development team experience the iteration of an

information product, the net benefit of choosing an authorized information sharing strategy is lower than that of a not authorized information sharing strategy.

(4) The eigenvalue of Jacobi matrix at equilibrium point  $E_4(0, 0, 1)$  is

$$\begin{cases} \lambda_1^{E_4} = R_{m1} - C_{m1} - C_{m2} - R'_{m1} + C'_{m1} + (\beta - 1)(R_{m1} - R'_{m1}), \\ \lambda_2^{E_4} = R_{d1} - C_{d1} - C_{d2} - R'_{d1} + C'_{d1} + (1 - \delta)(C_{d1} - C'_{d1}), \\ \lambda_3^{E_4} = -(R_{u3} - C_u - R'_{u3}) = -\lambda_3^{E_1}. \end{cases} \quad (20)$$

It can be seen from  $\lambda_3^{E_4} = -\lambda_3^{E_1}$  that  $E_1(0, 0, 0)$  and  $E_4(0, 0, 1)$  cannot be evolutionarily stable strategies at the same time. When  $\beta R_{m1} - C_{m1} - C_{m2} < \beta R'_{m1} - C'_{m1}$ ,  $R_{d1} - \delta C_{d1} - C_{d2} < R'_{d1} - \delta C'_{d1}$ , and  $R_{u3} - C_u > R'_{u3}$ ,  $E_4(0, 0, 1)$  is the evolutionarily stable strategy. After the product is upgraded, because the benefits of the upgraded product for the authorized information users are much greater than those for the unauthorized information sharing or the users' weak awareness of information security, the net profit of authorized information sharing is greater than that of unauthorized information sharing. Therefore, the user will choose the authorization information sharing policy. It can be seen that the lower the cost of users' authorized information sharing (such as additional potential losses such as privacy disclosure), the greater the probability of users choosing authorized information sharing.

(5) The eigenvalue of the Jacobi matrix at  $E_5(1, 1, 0)$  is

$$\begin{cases} \lambda_1^{E_5} = -(R_{m1} - C_{m1} + \Delta R_{m1} - R'_{m1} + C'_{m1} - \Delta R'_{m1} + C_{m2}) = -\lambda_1^{E_3}, \\ \lambda_2^{E_5} = -(R_{d1} - C_{d1} + \Delta R_{m1} - R'_{d1} + C'_{d1} + C_{d2}) = -\lambda_2^{E_2}, \\ \lambda_3^{E_5} = R_{u1} - C_u - R'_{u1}. \end{cases} \quad (21)$$

It can be concluded from (21) that  $E_5(1, 1, 0)$ ,  $E_2(1, 0, 0)$ , and  $E_3(0, 1, 0)$  cannot become an evolutionary stability strategy at the same time. In order for  $E_5(1, 1, 0)$  to be ESS,  $R_{m1} - C_{m1} + \Delta R_{m1} > R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2}$ ,  $R_{d1} - C_{d1} + \Delta R_{m1} > R'_{d1} - C'_{d1} - C_{d2}$ , and  $R_{u1} - C_u < R'_{u1}$  must be satisfied simultaneously. At this point, the sum of the net benefits of the product manager's proposed experience-oriented demand and the collaborative benefits of the design and developmental team's experience design is greater than the sum of the net benefits of the product manager's proposed benefit-

oriented demand and the design team's developmental and experience design. The sum of the synergistic benefits from the experience design and development of the design and development team is higher than the difference between the net benefits from agile development and design sprint. The performance losses are caused by the failure to develop according to the experience needs of the product manager. The net income of authorized information sharing by users is lower than that of unauthorized information sharing. In this case, users cannot get enough profit from the behavior strategy

of authorization information and eventually tend to choose the strategy of nonauthorization information sharing.

(6) The eigenvalue of the Jacobi matrix at  $E_6(1, 0, 1)$  is

$$\begin{cases} \lambda_1^{E_6} = -(R_{m1} - C_{m1} - C_{m2} - R'_{m1} + C'_{m1} + (\beta - 1)(R_{m1} - R'_{m1})) = -\lambda_1^{E_4}, \\ \lambda_2^{E_6} = R_{d1} - C_{d1} - R'_{d1} + C'_{d1} + \Delta R_{m1} + C_{d2} + (1 - \delta)(C_{d1} - C'_{d1}), \\ \lambda_3^{E_6} = -(R_{u2} - C_u - R'_{u2}) = -\lambda_3^{E_2}. \end{cases} \quad (22)$$

According to  $\lambda_1^{E_6} = -\lambda_1^{E_4}$  and  $\lambda_3^{E_6} = -\lambda_3^{E_2}$ ,  $E_6(1, 0, 1)$ ,  $E_2(1, 0, 0)$ , and  $E_4(0, 0, 1)$  cannot be evolutionarily stable strategies at the same time. When  $\beta R_{m1} - C_{m1} - C_{m2} > \beta R'_{m1} - C'_{m1}$ ,  $R_{d1} - \delta C_{d1} + \Delta R_{m1} < R_{d1} - \delta C'_{d1} - C_{d2}$ , and  $R_{u2} - C_u > R'_{u2}$ ,  $E_6(1, 0, 1)$  is the evolutionary stable strategy. In this case, the product manager and user choose to share experience-oriented requirements and authorization

information, respectively, to get more profit, and the design and development team chose agile development and design sprint strategy because of technical constraints and high development cost.

(7) The eigenvalue of Jacobi matrix at equilibrium point  $E_7(0, 1, 1)$  is

$$\begin{cases} \lambda_1^{E_7} = R_{m1} - C_{m1} - R'_{m1} + C'_{m1} + \Delta R_{m1} - \Delta R'_{m1} + C_{m2} + (\beta - 1)(R_{m1} - R'_{m1}), \\ \lambda_2^{E_7} = -(R_{d1} - C_{d1} - C_{d2} - R'_{d1} + C'_{d1} + (1 - \delta)(C_{d1} - C'_{d1})) = -\lambda_2^{E_4}, \\ \lambda_3^{E_7} = -(R_{u2} - C_u - R'_{u2}) = -\lambda_3^{E_3}. \end{cases} \quad (23)$$

It can be concluded from (23) that  $E_7(0, 1, 1)$ ,  $E_3(0, 1, 0)$ , and  $E_4(0, 0, 1)$  cannot become evolutionary stability strategy at the same time. If  $\beta R_{m1} - C_{m1} + \Delta R_{m1} < -\beta R'_{m1} + C'_{m1} - \Delta R'_{m1} + C_{m2}$ ,  $R_{d1} - \delta C_{d1} - C_{d2} > R'_{d1} - \delta C'_{d1}$ , and  $R_{u2} - C_u > R'_{u2}$  are simultaneously true,  $E_7(0, 1, 1)$  is an evolutionarily stable strategy. In this case, the design and

development team and users can make more profits by choosing experience design strategy and authorization information sharing strategy, respectively.

(8) The eigenvalue of the Jacobi matrix at  $E_8(1, 1, 1)$  is

$$\begin{cases} \lambda_1^{E_8} = -(R_{m1} - C_{m1} - R'_{m1} + C'_{m1} + \Delta R_{m1} - \Delta R'_{m1} + C_{m2} + (\beta - 1)(R_{m1} - R'_{m1})) = -\lambda_1^{E_7}, \\ \lambda_2^{E_8} = -(R_{d1} - C_{d1} - R'_{d1} + C'_{d1} + \Delta R_{m1} + C_{d2} + (1 - \delta)(C_{d1} - C'_{d1})) = -\lambda_2^{E_6}, \\ \lambda_3^{E_8} = -(R_{u1} - C_u - R'_{u1}) = -\lambda_3^{E_5}. \end{cases} \quad (24)$$

$\lambda_1^{E_8} = -\lambda_1^{E_7}$ ,  $\lambda_2^{E_8} = -\lambda_2^{E_6}$ , and  $\lambda_3^{E_8} = -\lambda_3^{E_5}$  indicate that  $E_8(1, 1, 1)$  and  $E_5(1, 1, 0)$ ,  $E_6(1, 0, 1)$ , and  $E_7(0, 1, 1)$  cannot be evolutionarily stable strategies at the same time.

In the context of big data, product managers put forward experience-oriented requirements, design and development teams conduct experience-oriented development, and users' authorized information sharing is an

ideal balance in the process of information product update and iterative development and design and also a benign interaction state expected to be realized between users and information product holders in the real world.

In order to achieve this ideal equilibrium state, namely, to ensure that  $E_8(1, 1, 1)$  is the only evolutionarily stable strategy, the following conditions need to be met:

- (i)  $\lambda_1^{E_8}, \lambda_2^{E_8}$ , and  $\lambda_3^{E_8}$  are all less than 0. Correspondingly,  $\beta R_{m1} - C_{m1} + \Delta R_{m1} > \beta R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2}$ ; in the case of user authorization information sharing, the sum of the net benefits of product manager proposing experience-oriented demand and the collaborative benefits of design and the development team carrying out experience design is greater than the sum of the net benefits of product manager proposing benefit-oriented demand and design team developing experience design.  $R_{d1} - \delta C_{d1} + \Delta R_{m1} > R'_{d1} - \delta C'_{d1} - C_{d2}$ ; the sum of the net benefits of the design and development team's experience design and the synergistic benefits brought by the product manager's experience cooperation work philosophy is higher than the net benefits of agile development and design sprint after deducting the performance loss caused by the conflict between the design team and the product manager's philosophy.  $R_{u1} - C_u > R'_{u1}$ ; the net benefit of user-authorized information sharing after product experience-oriented & experience-oriented upgrading is higher than that of nonauthorized information sharing strategy.
- (ii) At least one of the inequalities in  $\lambda_1^{E_1} > 0, \lambda_2^{E_1} > 0$ , and  $\lambda_3^{E_1} > 0$  is true. This means that  $R_{m1} - C_{m1} - C_{m2} > R'_{m1} - C'_{m1}$ ; after deducting the coordination cost caused by the inconsistency between the product manager and the design and development team, the net benefit of the experience-oriented demand proposed by the product manager is higher than the benefit-oriented net benefit.  $R_{d1} - C_{d1} - C_{d2} > R'_{d1} - C'_{d1}$ ; after deducting the performance loss caused by the inconsistency of the design and development team and product manager, the net benefit of experience design of the design and development team is higher than that of agile development and design sprint.  $R_{u3} - C_u > R'_{u3}$ ; the net benefit of user-authorized information sharing is higher than that of non-authorized information sharing strategy after product benefit-oriented and agile development upgrade.
- (iii) At least one of the inequalities in  $\lambda_1^{E_2} > 0, \lambda_2^{E_2} > 0$ , and  $\lambda_3^{E_2} > 0$  is true. Correspondingly,  $R_{m1} - C_{m1} - C_{m2} < R'_{m1} - C'_{m1}$  implies the opposite of the first inequality in (ii). The sum of the net benefits of the product manager's proposed experience-oriented demand and the collaborative benefits brought by the design and developmental team's experience design is greater than the net benefits of the product manager's proposed benefit-oriented demand after deducting the coordination costs inconsistent with the design and development team's concept.  $R_{u2} - C_u > R'_{u2}$ ; after only one of the designers and developers updates information products based on experience orientation, the net income of authorized information sharing by users is higher than that of unauthorized information sharing.
- (iv) At least one of the inequalities in  $\lambda_1^{E_3} > 0, \lambda_2^{E_3} > 0$ , and  $\lambda_3^{E_3} > 0$  is true. This means that  $R_{m1} - C_{m1} + \Delta R_{m1} > R'_{m1} - C'_{m1} + \Delta R'_{m1} - C_{m2}$ ; the sum of the net benefits of the product manager proposing experience-oriented demand and the collaborative benefits of the design and development team carrying out experience design is greater than the sum of the net benefits of the product manager proposing benefit-oriented demand and design team developing experience design.  $R_{d1} - C_{d1} - C_{d2} < R'_{d1} - C'_{d1}$  is the opposite of the second inequality in (ii).  $R_{u2} - C_u > R'_{u2}$  has the same meaning as the last inequality in (iii).
- (v) At least one of the inequalities in  $\lambda_1^{E_4} > 0, \lambda_2^{E_4} > 0$ , and  $\lambda_3^{E_4} > 0$  is true. Correspondingly,  $\beta R_{m1} - C_{m1} - C_{m2} > \beta R'_{m1} - C'_{m1}$ ; in the case of user authorization information sharing, after deducting the coordination cost caused by the inconsistency between the product manager and the design and development team, the net income proposed by the product manager for experience-oriented demand is higher than the net income for benefit-oriented demand.  $R_{d1} - \delta C_{d1} - C_{d2} > R'_{d1} - \delta C'_{d1}$ . In the case of user authorization information sharing, after deducting the performance loss caused by the inconsistency between the design and development team and the product manager, the net benefit of the design and developmental team from experience design is higher than the net benefit of agile development and design sprint.  $R_{u3} - C_u < R'_{u3}$ , contrary to the meaning of the last inequality in (ii).

$E_8(1, 1, 1)$  is the only evolutionarily stable strategy if and only if (I)-(v) are both satisfied.

Through the above analysis, we can find that the user information security cost has an important influence on the choice of user strategy, but when the design and development team and the product manager make the choice of experience design strategy, they are unaffected by potential loss due to user data breach. As a profit-oriented information product, it can be further developed in the commercial promotion mode of health QR code, which should not overemphasize the profit and neglect the full protection of data security. This will aggravate the conflict between the user and the information product holding enterprise and is not conducive to extending the life cycle of the Internet information product. At the same time, the design development team and product manager's choice of experience design strategy is mainly affected by the expected revenue of different strategies. If product managers and design development teams can benefit more from this strategy (such as increasing the number of new users and

increasing the stickiness of users) through user-experience-centered information product design iterations, the impact is further amplified by the Revenue Enhancement Factor ( $\beta$ ) and cost reduction factor ( $\delta$ ) that result from the sharing of user-authorized information; the greater the probability that the product manager and the design and development team will choose a user-experience-oriented development concept, the better the interaction between the information product owner and the user is. In the process of information product design, service thinking and experience thinking need to be introduced in order to understand its own complexity [27]. To this end, its stakeholders should strengthen the awareness of the crisis, strengthen data security protection, reduce the cost of user information sharing, change the design concept of product experience to improve user stickiness, and provide users with more quality services, to extend the life cycle of health QR code products.

## 5. Conclusions and Discussions

Internet product experience design, which involves product managers, design and development teams, and users, is an effective iteration of health QR code product renewal. From the point of view of the product manager, it is benefit and function first; from the point of view of the design and development team and from the point of view of users, it is to use the service of information products to meet related needs. We should promote the health QR code information experience design through the tripartite cooperation drive, and under the premise of user information security, accurately excavate and guide user demand and plan the future development trend of information products. In the process of market research, requirement analysis, interaction and visual design and development, market operation, version iteration, and update of health QR code product, the strategy choice of the participants is grasped, to explore the role and value of product manager, design, and development team and users.

Based on the analysis and research of experience design of health QR code products, we can discuss and think about the following problems. First, Internet product experience design is an extension of traditional industrial design, integrating information product demand, user experience, and value efficiency. Secondly, in the industrial era, the focus is on function, quality, and the bulk copy of the goods. In the Internet age, the emphasis is on business and users, faster access to goods, and enhanced experience. In the age of the Internet of things, data and demand are valued, and differentiation demands are met with precision. Finally, the Internet product experience designer needs to master the scene, the mode, and the emotion design. In the user demand data, user behavior parameters, software and hardware integration, information products workflow innovation are needed. Therefore, in industrial design, the design method combines the user and the technology. In Internet experience design, design thinking combines users, business models, and technology. In Internet experience design, data design thinking combines user, business model, and technology.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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## References

- [1] B. Schmitt, *Experiential Marketing, How to Get Customers to Sense, Feel, Think, Act and Relate to Your Company and Brands*, The Free Press, New York, NY, USA, 1999.
- [2] C. Alan, *About Face: The Essentials of Interaction Design*, John Wiley & Sons, Hoboken, NJ, USA, 2014.
- [3] J. G. Jesse, *The Elements of User Experience: User-Centered Design for the Web and Beyond*, New Riders, San Francisco, CA, USA, 2010.
- [4] International Organization for Standardization [ISO], *Ergonomics of Human-System Interaction-Part 210: Human-Centered Design for Interactive Systems*, ISO, Geneva, Switzerland, 2010, <https://www.iso.org/standard/77520.html>.
- [5] F. Wang, Y. Guo, W. He Liao, and B. Sheng Wu, "Knowledge push technology for complex mechatronic products design based on ontology and variable precision rough set," *Applied Mechanics and Materials*, vol. 799, no. 800, pp. 1107–1112, 2015.
- [6] C. R. Li and Z. J. Ma, "Dynamics analysis of a mathematical model for new product innovation diffusion," *Discrete Dynamics in Nature and Society*, vol. 2020, Article ID 4716064, 13 pages, 2020.
- [7] Y. Feng and S. Zhang, "Intelligent push method of CNC design knowledge based on feature semantic analysis," *Computer Integrated Manufacturing Systems, CIMS*, vol. 22, no. 1, pp. 189–201, 2016.
- [8] A.-L. Barabási and R. Albert, "Emergence of scaling in random networks," *Science*, vol. 286, no. 5439, pp. 509–512, 1999.
- [9] K. Yang, Y. Li, Y. Xiong, W. Li, and H. Na, "Knowledge driven product innovation design based on complex network," *Computer Integrated Manufacturing Systems*, vol. 21, no. 9, pp. 2257–2269, 2015.
- [10] A. Cooper, *About face, The Essentials of Interaction Design*, John Wiley & Sons, Hoboken, NJ, USA, 2014.
- [11] D. A. Norman and R. Verganti, "Incremental and radical innovation: design research vs. Technology and meaning change," *Design Issues*, vol. 30, 2020.
- [12] J. Richard and R. Boland Jr, "Fred collopy," *Managing as Designing*, Stanford University Press California, Redwood City, CA, USA, 2004.
- [13] Wikipedia, *What Is Agile Development*, Wikipedia, San Francisco, CA, USA, 2021, [https://en.wikipedia.org/wiki/Agile\\_software\\_development#cite\\_note-Beck\\_Beedale\\_Bennekum\\_Cockburn\\_p.-3](https://en.wikipedia.org/wiki/Agile_software_development#cite_note-Beck_Beedale_Bennekum_Cockburn_p.-3).
- [14] W. Thomas, *Design for Dasein: Understanding the Design of Experiences*, Create Space Independent Publishing, New York, NY, USA, 2015.
- [15] Wikipedia, *What Is Design Sprint*, Wikipedia, San Francisco, CA, USA, 2021, [https://en.wikipedia.org/wiki/Design\\_sprint](https://en.wikipedia.org/wiki/Design_sprint).

- [16] X. R. Li, S. H. Yu, J.-J. Chu, D.-K. Chen, and L.-J. Wu, "Double push strategy of knowledge for product design based on complex network theory," *Discrete Dynamics in Nature and Society*, vol. 2017, Article ID 2078626, 15 pages, 2017.
- [17] K. W. Collier, *Agile Analytics: A Value-Driven Approach to Business Intelligence and Data Warehousing*, Addison-Wesley Professional, Boston, MA, USA, 2011.
- [18] G. Jansson, E. Viklund, and H. Lidelöw, "Design management using knowledge innovation and visual planning," *Automation in Construction*, vol. 72, pp. 330–337, 2016.
- [19] D. Friedman, "Evolutionary games in economics," *Econometrica*, vol. 59, no. 3, pp. 637–666, 1991.
- [20] H. M. Abdulmajid, "Capturing software-engineering tacit Knowledge," in *Proceeding of the 2nd Conference on European Computing Conference*, pp. 132–137, World Scientific and Engineering Academy and Society (WSEAS), Stevens Point, WI, USA, 2008.
- [21] M. A. owak and K. Sigmund, "Evolutionary dynamics of biological games," *Science*, vol. 303, no. 2, pp. 793–799, 2004.
- [22] Q. L. Zou and J. A. Ma, "Value of mass media in food safety information disclosure from the perspective of big data," *Journal of Food Quality*, vol. 2020, Article ID 8854238, 13 pages, 2020.
- [23] X. C. Qu and G. S. Hou, "Governance of platform information security based on tripartite evolutionary game," *Journal of Modern Information*, vol. 40, no. 7, pp. 114–125, 2020.
- [24] Y. H. Wei, X. L. Chen, and X. F. Zou, "Evolutionary game analysis of personal information protection based on data sharing," *Inquiry into Economic Issues*, vol. 12, pp. 79–88, 2019.
- [25] K. Ritzberger and J. W. Weibull, "Evolutionary selection in normal-form games," *Econometrica*, vol. 63, no. 6, pp. 1371–1399, 1995.
- [26] Y. Fang, W. Wei, F. Liu, S. Mei, L. Chen, and J. Li, "Improving solar power usage with electric vehicles: analyzing a public-private partnership cooperation scheme based on evolutionary game theory," *Journal of Cleaner Production*, vol. 233, pp. 1284–1297, 2019.
- [27] A. Donald, *Norman, Living with Complexity*, The MIT Press, Cambridge, MA, USA, 2011.