Research on innovative Internet pension products diffusion based on system dynamics

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Abstract: Now, a series of policies and measures have been issued to promote the development of "Internet + elderly care services", how to promote the effective diffusion of Internet elderly care innovative products has become urgent. According to the communication theory, this paper analyzes the process of information adoption, builds a dynamic model of the diffusion process of Internet pension innovation products, uses Vensim PLE to test the flow chart model, and conducts simulation from three aspects: the convenience of Internet devices, the support of pension innovation policies, and average network path length. The study found that the government should formulate policies to encourage innovation and implement relevant measures. By adopting reasonable government subsidy coefficient and suitable Internet equipment for aging, the elderly can be promoted to adopt innovative Internet pension products. Finally for enterprises, they can choose nodes with short Internet paths and high network averages for large-scale promotion to improve the diffusion rate of Internet elderly care innovative products.

Keywords: Innovation diffusion, Pension technology products, system dynamics, simulation analysis

1 Introduction

With the rapid development of the new generation of information technology such as intelligent terminals, mobile Internet, big data and artificial intelligence, the integration and innovation of "Internet + healthy elderly care" has been deepening, which has a large number of innovative products and operation models. Innovative Internet pension products refer to a series of material products that integrate scientific and technological elements based on the physiological, psychological and social needs of the elderly. They aim to build a smart health service system that covers the whole life cycle of prevention, medical treatment, rehabilitation, nursing, hospice care, etc. by relying on Internet platforms, mobile applications (APPs), so as to realize the healthy care of the elderly.

Meng Q stresses China's intelligent elderly care is at an early stage, it is indispensable that government should issue relevant policies to provide strong support for the further development of the new industrial pattern.[1]With the popularization of network and the necessity of daily life, intelligent devices play a promoting role in providing public services. Therefore, it is extremely important to design aging Internet devices. [2]Based on TAM model, people consider the usefulness and ease of use of technology when considering whether to accept innovative technology or products.[3] By using a questionnaire and survey, Visutsak P concludes that the successful promotion of smart home technology not only improves the smart technology itself, but also

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requires the needs, concerns, concepts and psychological accessibility of the elderly. [4]Zhou J uses neighborhood rough set theory to address the smart elderly care in multi-level attributes, the result indicates that subjective conceptions has impact on decision attribute.[5]

Due to the innovative development of "Internet + pension" is still in its infancy, and there is not much data available at present, this paper refers to previous research. Based on the process of elderly consumer's access to the product information, and starting from the adoption analysis and decision-making process of elderly users, this paper constructs an innovative Internet pension product by using system dynamics, which is advantages in dealing with complex systematic problems. It is then used to explore the impact of Internet device convenience, the support of pension innovation policy and average network path length on the adoption process of innovative Internet pension products, so as to provide some theoretical implications for the implementation of the national policy on "scientific and technological innovation to deal with aging".

2 Consumer information acquisition and adoption decisions

Consumers' adoption of new products goes through three processes, which is shown in Fig.1.

2.1 Product information acquisition

Most of the elderly are in the "information siege", but the development of new things also imperceptibly affects the thinking patterns of the elderly. Before the adoption of innovative Internet pension products, elderly users should first know the existence and relevant information of the products. The acquisition of innovative information can be targeted through mass media such as TV news, newspapers, advertisements and other traditional ways, as well as new media such as Internet TV, electronic magazines, microblogging. Interpersonal communication can help people provide relevant information about innovative products, such as availability, ease of use and product use risk, through offline oral communication or online chat tools such as Wechat, QQ and other software, so as to affect consumers who may have adoption intentions.

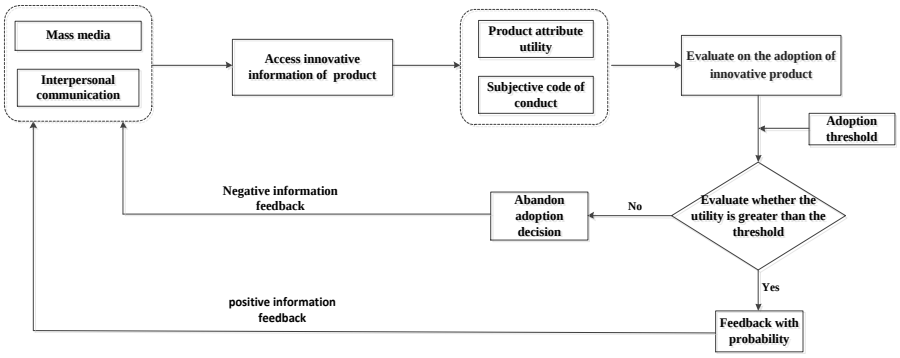

Fig. 1. Schematic diagram of user adoption decision process [Owner-draw]

2.2 Evaluation on the adoption of innovative

Then the users will evaluate the utility of Internet pension innovative products according to their acceptance ability before choosing whether to adopt them. This process may also be affected by

the fluctuation of some random factors. Only when the evaluation is greater than their psychological expectation will the elderly really adopt the products. The evaluation of adoption is divided into two parts[6]: one is the attribute utility of the product. It refers to the satisfaction of consumers brought by the product's own functions and features. The second is the acceptance ability of elderly users. It mainly refers to the ability of elderly users to accept innovative products based on their own learning and consumption ability under the conditions of the convenience of using different Internet devices.

2.3 Adoption of innovative products

At last, in the process of adopting innovative products, the consumers of the adopters will set a maximum value for the adoption cost of innovative products, which is also the lowest expected level of innovative products. This maximum value is the adoption threshold. Users will compare the willingness to adopt with the mental threshold[7]. When the assessed threshold is greater than the threshold, the innovative Internet pension product will be adopted with a certain probability, and the information will be fed back to potential adopters positively. When the utility of the evaluation is less than the threshold, potential adopters will give up the innovative product and give negative feedback by mass media, interpersonal communication[8].

3 Construction of system dynamics model of innovative Internet pension product diffusion

3.1 Construction of system flow diagram model

Based on the analysis of consumer information acquisition and adoption decisions, this paper analyzes key variables that affect the diffusion of Internet innovative products over the Internet, considers the nature of variables and the interaction process between variables, and builds SD flow pattern of innovative Internet pension products, shown in Fig.2.

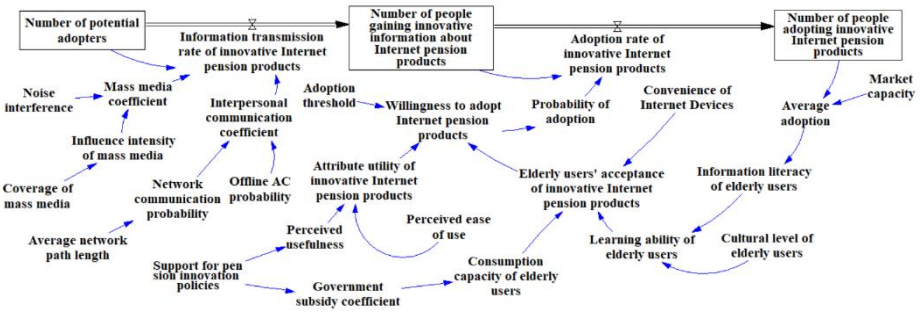

Fig. 2. Flow chart of Internet pension innovation product diffusion [Owner-draw]

3.2 Main model equation

1) Number of potential adopters=INTEG (-Information transmission rate of innovative Internet pension products, 2250)

2) Number of people gaining innovative information=INTEG (Information transmission rate of innovative Internet pension products,0)

3) Number of people adopting innovative Internet pension products=INTEG (Adoption rate of innovative Internet pension products,0)

4) Information transmission rate of innovative Internet pension products= Number of potential adopters* (Interpersonal communication coefficient+ Mass media coefficient)

5) Adoption rate of innovative Internet pension products= Number of people gaining innovative information * Probability of adoption

6) Network communication probability =1/ average network path length

7) Interpersonal communication coefficient = network communication probability + offline AC probability

8) Attribute utility of innovative Internet pension products=Perceived usefulness+ Perceived ease of use

9) Mass media coefficient =Influence intensity of mass media-Noise interference

10) Willingness to adopt Internet pension products= Elderly users' acceptance of innovative Internet pension products +Attribute utility of innovative Internet pension products- Random interference value

11) Elderly users' acceptance of innovative Internet pension products= (Learning normative ability of elderly users+ Consumption capacity of elderly users) *Convenience of Internet Devices

12) Learning ability of elderly users= Information literacy of elderly users+ Cultural level of elderly users

In order to prevent the system from being too complex, the input conversion relationship between variables in the model is treated as a linear function. In this paper, it will be set by means of table function, and its value will be uniformly limited to the [0,1] interval.

4 Model simulation and result analysis

4.1 Initial conditions and parameter design of the model

In this paper, Vensim PLE is used for simulation and analysis, setting initial time=0, final time =100, time step=0.25, units for time: weeks.

Without affecting the trend change and comparability of the diffusion system dynamic model, this paper presents a group of random data within the allowable range of theoretical analysis as simulation data, as shown in Table 1.

Table 1. Model initial parameter setting

Parameter setting	Assignment	Parameter setting	Assignment
Coverage of mass media	0.50	Offline AC probability	0.25
Average network path length	6	Support for pension innovation policies	0.60
Perceived ease of use	0.55	Convenience of Internet Devices	0.50
Cultural level of elderly users	0.48	Market capacity	2250

4.2 Simulation design and result analysis

Through continuous debugging and Simulation of the diffusion system model, this paper analyzes three factors that have a great impact on the adoption rate of Internet pension innovative products as follows.

4.2.1 Impact of innovation policy support.

Impact of innovation policy support. Keep other variables the same, set the value of innovation policy support to 0.2, 0.5 and 0.8, the simulation results are shown in Fig.3 and Fig.4.

From Fig.3 and Fig.4, improving the support of the innovation policy can promote the transmission rate of innovative Internet elderly care products. The support of the elderly care innovation policy includes two levels: diffusion source and diffusion acceptance. From the perspective of diffusion source, the policy support can help enterprises improve the relative advantages of products and obtain economic benefits from cost saving, output improvement and other aspects through innovation incentive policies and tax reduction policies; From the perspective of diffusion acceptance ,the purchase subsidies for Internet pension innovative products through policies can reduce the adoption costs and risks of elderly users, thus accelerating the diffusion of Internet pension innovative products.

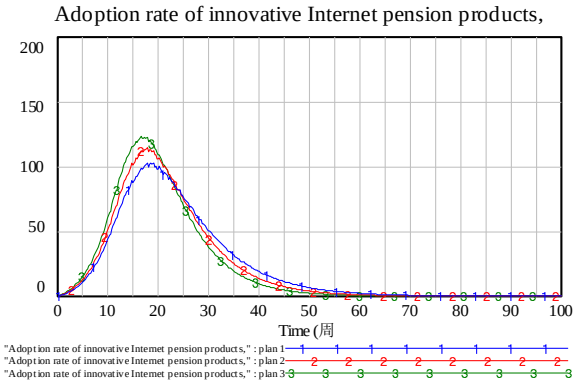

Fig. 3. The change trend of the number of consumers adopted [Owner-draw]

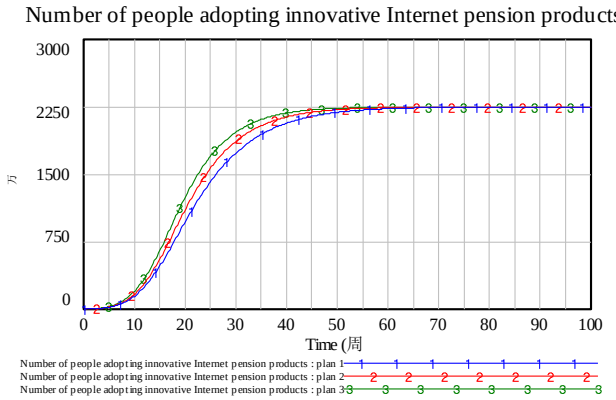

Fig. 4. Adoption rate change trend [Owner-draw]

4.2.2 Impact of convenience of Internet equipment.

Keep other variables the same, set the value of innovation policy support to 0.2, 0.5 and 0.8, the simulation results are omitted due to space limitation

After the convenience of Internet equipment is improved, the adoption rate curve of Internet elderly care innovative products becomes steeper. Because the improvement of Internet equipment can reduce the technical threshold for the elderly to use the Internet, obtain more scientific and technological experience, and reduce the adverse impact of the digital divide. Under the same consumption ability and learning standard ability, the process of learning and using smart devices for the elderly is more convenient, so as to improve the subjective acceptance ability of Internet elderly care innovative products, thereby enhancing the willingness of elderly users to adopt Internet innovative products and promoting the diffusion of Internet elderly care innovative products.

4.2.3 Impact of average network path length.

Keep other variables the same, set the value of Average network path length to 3, 6 and 9, the simulation results are omitted due to space limitation.

It can be seen from the above figure that the increase of the average path length of the network will increase the difficulty of communication between different user nodes and greatly reduce the overall efficiency of the diffusion of Internet financial innovation products in the system. The main reason is that with the increase of the average path length of the network, it is more difficult for any consumer in the network to exchange information, which reduces the influence coefficient of interpersonal communication, thus delaying the whole process of new product diffusion.

5 Conclusion

Based on the communication theory and the analysis of the decision-making process of the adopters, this paper uses system dynamics to construct a flow chart model of the diffusion of

Internet pension innovative products. On the one hand, it can reflect the impact of micro adoption behavior in the process of Internet communication and adoption, and on the other hand, it also considers the impact of the information dissemination of innovative products on the diffusion process of Internet pension innovative products based on the actual situation. Through simulation, it can be seen that the three factors of the support strength of the elderly care innovation policy, the convenience of using Internet equipment and the average path length of the network have a positive impact on the diffusion of Internet elderly care innovation products. From the perspective of the government, it should play a "leading role" to comprehensively consider all stakeholders after formulate policies to encourage innovation, implement relevant measures and improve the relative advantages of Internet elderly care products. At the same time, it also necessary to pay attention to the needs of the elderly users, provide more convenient Internet equipment, improve the Internet awareness of the elderly users and encourage the elderly to adopt innovative Internet elderly care products through a reasonable government subsidy coefficient. For enterprises, when promoting Internet elderly care innovative products, they can choose nodes with short Internet paths and high network averages for large-scale promotion. For example, they can find some new media accounts with large numbers of fans to promote, so that more people can obtain relevant information about Internet elderly care innovative products, and stimulate the consumption of elderly users through lottery and other welfare methods to improve the diffusion rate of Internet elderly care innovative products.

Acknowledgement

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