Research on Development Cost Control of Military Management System Software of Financial Information Based on Game Theory

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Abstract: This paper analyses the existing problems in the entrust process of the financial information management system software development to the local software company by the military and makes use of the theoretical tool of the incomplete information and multistage repeated games in the game theory. The paper analyses the game model of the entrust process of the related system software to the software company by the military and explains the necessity of the commission from the perspective of the game theory. Based on the above analysis, the paper provides some reasonable and feasible suggestions and opinions to avoid the problems for the military.

Keywords: repeated game theory, financial, software development

1. INTRODUCTION

As an important part of military application software, the military financial information management system plays a more and more important role in the military work related with the finance. However, with the deepening of the development and construction of the armed forces, the complexity of dealing with the financial related business is becoming more and more complicated, and the complexity of the corresponding military financial information management system software is increasing. The traditional development model limited in the military scientific research institutes have failed to meet the needs of the evolving business.

Therefore, some development tasks of the military financial information management system software can be entrusted to the local software companies to do the research and development, such as the software with complex relationship, high technical development requirements, relatively mature civilian technology and the relatively low confidentiality requirements.

On one hand, the new approach can save costs, helping the limited military scientific research institutes and technical personnel to put the energy into the development of the software with high security requirements, not involved with the civil technology and the military urgent need software. On the other hand, the military can learn the advanced management model and the high development technology to improve the scientific research level of the military research institutes [1].

However, from the perspective of the present situation that local software companies bear the software development projects of the military financial information management system, the price is commonly too high. although the military department wants to reduce the development costs of the military financial information management system software, the effect is not obvious. The local software company's research and development cost is even several times more than the cost of the similar military research institutes to develop the army financial information management system software.

Even we do not consider the cost difference between the military research institutes and the local software company, the development cost of the local software company is very high. At the same time, if the military find some problems in the cooperation process with the local software company, it is very difficult for the military to replace the company for other local software company when the military consider to replace the company. Even when there are some new projects in the future, the military have to cooperate with the previous local software company. Thus, the development projects of the military financial information management system software are monopolized by a single company. It is an important concern to effectively avoid the monopoly behaviour of a single company, establish a reasonable research and development cost of the military financial information management system software and enhance the utilization effectiveness of the military funds when the military selects the local software company in the process of the entrust of the development of the military financial information management system software.

This paper will make use of the theoretical tool of the multi-stage repeated game theory in the game theory, analyse the possible problems in the process of the development entrust of the military financial information management system software by the military to the local software company and propose the corresponding suggestions and opinions.

2. REPEATED GAME THEORY

The military commissions the local software companies to research and develop the military financial

information management system software, which actually formed a game relationship between the military and local software companies. In general, a military financial information management system software needs several stages to complete. For example, the first phase of research and development is to develop the budget software. The second phase of research and development is to develop the settlement and reimbursement software. The third phase of research and development is to develop the final accounts software and so on. Each stage constitutes a game of a stage. The whole process can be viewed as repeated games.

The repeated game is a special form of the dynamic game. It refers to the repeated games of the same structure for many times or even infinite times. Each game of the whole game process for one time is called "stage game". In the process of the "stage game", the behaviors of the participants can be observed. The participants can conduct the behaviors at the same time, or they are conduct the behaviors at different times. Therefore, the behaviors of the participants in each stage rely on the behaviors selections of other participants [2].

The repeated game has the characteristics as follows:

First, the "material" relationship among the repeated games of all the stages do not exist. That is to say, the game of the previous stage do not change the structure of the game of the latter stage. In the development process of the entrust of the development of the military financial information management system software by the military to the local software company, the selection of the military in the previous stage does not have the "material" relationship with the decision of the military in the latter stage. Even if the military selects a company to develop the military financial information management system software in the first stage, if the local software company charges very high in the second stage or the submitted product by the company does not satisfy the military requirements, the military can replace the company for other company.

Second, in each stage of the repeated games, all the participants can observe the game history. In the game process of the game of each stage, all the behaviors of the military and the local software company can be observed.

Third, the total revenue of the participants is the sum of the discounted values or weighted averages of the proceeds of the game at all stages. Affected by the time value of the fund, the discount value here can be expressed as a discount factor, that is, the value of the next unit's payment at this stage. In this article, it refers to the value used for the research and development of the software in the previous stage provided by the military for the local software company in the latter stage.

The main factors affecting the equalization results are the times for the repeated games and the completeness of information [3]. In the process of the repeated games, the participants need the equalization of the short-term interests and long-term interests. They may sacrifice the short-term interests for the long-term interests to select other equalization decision. In the process of the military financial information management system software, the games between the military and the local software company can be considered as the repeated games for uncertain times. The more stages the two sides cooperate, the more profits the two sides make. No matter the military or the local software company, both of them are seeking long-term interests.

The completeness of information affects the equalization results of the repeated games lies in the following fact. If each participant's payment function is not known by other participants, the participant is likely to actively establish a good reputation in order to seek long-term interests. In this paper, the actual payment function of local software companies is not known by the military, so the military needs to take appropriate measures to establish the reasonable cost of developing software.

3. ANALYSIS OF THE QUESTION

(1) Basic Assumptions

A. According to the previous analysis, we determine the participants of the game are the military and the local software company. At the same time, we assume that both the military and the local software company have the "economically rational" attribute in the process of the development of the military financial information management system software. The two sides take the maximization of their respective interests as the starting points.

B. Assume the number of the participant of the military is only one, expressed by p. There are many local software companies participating the game, which are expressed by i. i=1,2, …, n. We use the -i to express other local software companies except the company of i. We use the a_p to express a particular behavior of the military, a_i to express a particular behavior of a local software company.

C. Although the games between the military and the local software company are considered the games of infinite times, we assume the games between the military and the local software company are only two-stage games for the sake of discussion.

D.The total payment of the military is the sum of the discounted values of each game payment. We assume the discount factor is and the value of it is set in the interval of (0, 1).

(2). Game orders

A. The local software company makes a bid according to the requirements of the military financial information management system software in the first stage of the military. Considering the developing cost of the company, the game behavior a_i' company i proposes the bid of the research and development fund Si'.

B. According to the bids of the local software companies and the value performance of the developed software qualities, the military conducts the behavior a_p' to select a local software company to develop the software.

C. According to the requirements of the military, the local software company complete the research and development of the software in the first stage.
D. The local software company makes a bid according to the requirements of the military financial information management system software in the second stage of the military. Considering the developing cost of the company, the game behavior ai' ' company i proposes the bid of the research and development fund Si' '.
E. According to the bids of the local software companies and the value performance of the developed software qualities, the military conducts the behavior ap' 'to select a local software company to develop the software.
F. The local software company completes the research and development of the software in the second stage as required.
Among the game orders, the first three steps are the first stage of the game, and the latter three steps are the second stage of the game.

(3). Game model
Assuming the military plans to pay the army financial information management system software gp for the price. g_i is the value of the product which the local software company i develops. The expected transaction price of the local software company is s and the value range of s is s. The final transaction price of the local software company i is s_i.

If the military selects a local software company, s_i is also the cost of the military for the development of the army's financial information management software. c represents the actual cost of developing a military financial information management system for local software companies, and c_i is the cost of research and development for the local software company i.
We assume the utility function of the military is the utility function of the local software companies. Assuming is the optimal strategy in the equilibrium case of the software company i selected by the military, it is the strategy that maximizes the overall strategy of the local software company i in all possible strategies. Represents the vector combined by the strategies of other local software companies except the company i. Therefore, the determination of the which is the optimal strategy of the company i implies.

(4). Game analysis
The military commissions the local software company to research and develop the military financial information management software, which belongs to the repeated game of indefinite times under incomplete information. The game is static at each stage, and the whole game is dynamic. The game process is the same at each stage. And in each stage of the static game, the strategies and actions are the same. According to the previous hypothesis, the repeated game consists of only two stages. The following is a backward induction method for repeated game analysis.
A. When T=2, the game is completed at this stage. For local software companies, when the military chooses to accept its military financial information management system software, the military utility function is . Among the above formula, is the replacement cost for the military to replace the local software company. When the military select the company of T=1, we get =0. Otherwise, >=0. The utility function of the local software company is i .
When the local software company choose the higher bid rather than the lower bid, the earning is greater than the low offer, and at T=1, the local software company i may make a low offer for military orders. However, the dominant strategy of local software companies at this stage must be high quotations. When local software companies choose to offer high prices, the military will decide whether to accept the local software company's bid of the military financial information management system software depending on the value of . If the military choose the local software company when T=1, the expectation effect is . Otherwise, the expectation effect is . is the replacement cost. The higher the is, the lower the and the small the military income is. When the increases, the decreases. Therefore, if the local software company want to obtain higher earnings, the local software company should make efforts to increase the replacement cost of the military in the development process of the military financial information management system software.

B.When T=1, the game is still in the first stage. Through a comprehensive assessment, the military selects a number of local software companies which are capable to successfully to develop the military financial information management system software. A number of companies participating in the bid model of "first-degree sealed price auction". These companies offer at the same time, and the military gets the quotes from the companies. At that time, the utility function of the local software company i: , which includes the value of the utility functions at the stage of T=1 and T=2.
When T=1, the local software company would definitely like to quote a high offer, considering the bids of other local software companies. If the offer is too high, the military will not choose this local software company. If the quoted price is too low, and the expected effect of the T=2 is not enough to compensate for the loss at this stage. The local software company has suffered a total loss of this software development, and will not undertake the task.
The military must choose a local software company to fulfil the development task. The military selection principle should be the price which is as low as possible, but it will also have some problems. The quality of the software offered lowly by the software company may indeed lower than that of the software offered higher by the software company. If the military chooses the local company only on the basis of a low offer, the quality of software development is better in the long run. But the companies with higher prices will quit the competition market and form a vicious circle.

Only considering the moment of the T=1, the local software company must choose the high price. However, if considering the effect of the moment of T=2 on the moment of T=1, the local software company may try to lower its price in order to obtain the military orders. The problem for the military is how to select the most cost-effective local company in many local companies rather than the company with the lower offer.
The local software company should choose the relative low price of its product e value at the moment of T=1, to increased probability of being selected by the military if it has the desire to successfully cooperate with the military. At the moment of T=2, the local software company must achieve the high profits through the increase of the research and development cost of the software to replace other software companies of the military.

C. According to the actual situation, the author finds that local software companies will increase military replacement costs in many ways. In particularly, the local software companies will use some of the methods that the military does not pay attention to achieve their goals. The local software companies design unique software research and development platforms, and the benefits are as follows. First, it will make software development more standardized and unified way of improving encoding; second, the research and development of software operation and development environment is more stable, especially for software use and the depth of research and development; third, they will save more cost of the latter development of software to improve resource utilization rate.
However, the adoption of research and development platform has brought many benefits of the quality of the software itself and the research and development process, it also brings about some implicit problems to the military. First, it greatly limits the scope of the military's choice of local software companies. Once the platform is selected for the software research and development, the software development of the later stage must be entrusted to the local software company. Otherwise, the software developed in the previous stage will be maintained expanding; second, the platform is constructed in a complicated way and subject to technical restrictions. If the military technical personnel will make use of the platform in the latter stage, they must go to the ground research and development unit for technical training. This virtually increases the cost of manpower; third, it increases the irreplaceable nature of local software companies' research and development software. If the military entrusts other units for software research and development, the previously developed software will cannot maintain and upgrade. The corresponding software will have to be redeveloped. The cost of software research and development has been greatly improved, and the previous data will be re - entered, which greatly increases the workload.
It is the optimal selection for the local software company i to take corresponding measures to design a software application development platform that limits the military's choice, and the military has to accept the price at a higher price for the moment of T=2 in the game.
Using the push back approach, the military select the local software company for the research and development of the software at the stage of T=1. If the military knows such a result in advance, it may not choose the company to do the research and development, and the transaction will fail. Therefore, the selection of the local software company by the military is very critical at the beginning of the game.

4. SUGGESTIONS AND OPINIONS

Through the previous analysis, the author believes that if the military wants to control the development cost of the military financial information management system software, we can make improvements from the following aspects.

(1) When the military entrust the local software companies to develop the military information management system software, the military should introduce a competition mechanism to expand the scope of choice of local software companies. The military can select a number of local software companies which meet the standards of developing software. Therefore, we can increase the competition among local software companies, and can choose a local software company to replace the inappropriate company in the early stage of software development.

(2) Analyses the own demands carefully to select the appropriate local software company. The suitable local software company is the success important link of the research and development of the military financial information management system software. The local software company must have successful related field experience to develop large software. The software environment and the database system should be universal to avoid the high costs in the research and development in the latter stage.

(3) When the military considering the price of the military financial information management system software quoted by the local software companies, the military must consider the value of the development product. The final income of the military is the value of the financial information management system software. The income is the final value subtracted actual payment of the research and development, not the single factor of the actual payment of the research and development.

(4) When the military considers the replacement of the software company, the military should adequately consider the replacement cost. In some conditions, the replacement cost of the military financial information management system software company is very high. Especially when the initial system is developed on the platform owned only by the local software company, the

latter replacement of the software company may lead to the waste of all the previous work.

(5) The military need to command the related information of the military financial information management system software as much as possible, especial the cost structure and the product quality of the development software of the local software company. If the military don't know the situation, the military can hire the experts from the military scientific research institutes as the supervisors to fulfil the development work of the military financial information management system software jointly.

5. CONCLUSIONS

With the deepening of civil military integration as well as the continuous development of military construction and the adjustment of the army's editing system, more and more tasks of the research and development of military management system software of financial information will be undertaken by the local military software companies. The military cost control and quality management of military financial information management system software are also becoming more and more important.

By introducing the theory of repeated games, the author studies the cost control problem in the process of developing related software products entrusted by the local software company. This paper establishes and analyses the game model of local software company commissioned by the military, explains the necessity of related problems, and put forward reasonable suggestions for the military to avoid possible problems. The research results of this paper can be applied not only in the cost control of the research and development of military financial information management system, but also can be applied in the cost control of other military software research and development.

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