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THE AFFECTING FACTORS OF IT ADOPTION -- INTEGRATING REAL OPTION THEORY AND INNOVATION DIFFUSION THEORY

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Abstract

The purpose of this paper is to investigate the relationships between the constructs of Real Option Theory (ROT) and Innovation Diffusion Theory (IDT) along with their impacts on new IT projects adoption. Unlike the more traditional techniques, real options theory explicitly accounts for uncertainty and future flexibility. Those variables are missed in all traditional innovation adoption theories (such as IDT), but are very important in situations dealing with structuring and timing investment decisions, especially in the face of high uncertain conditions such as new IT project. Three types of option are utilized in this study. They are 1) the building options mainly included explore options (including prototype options and pilot options), stage options, and lease options, 2) the operation options mainly included contract options, change-scale options, switch-use options, and abandon options, and 3) the growth options included strategic growth options. This study will investigate the impacts of these three option types on the main features of IDT, including relative advantages, compatibility, complexity, testability, and results demonstrability of innovation. Parametric uncertainty is used as a moderator of above relationships. The major contribution of this research model is to enhance and extend the IDT by adding two important constructs, uncertainty and managerial flexibility of the innovation.

Keywords: Real Option Theory, Innovation Diffusion Theory, innovation adaption, IT innovation project.
1 INTRODUCTION

It is an irreversible tendency from the industrial society to the information society with the rapid development of new technology revolution. The new technology revolution is represented by global economy and the computer and network technology. In such dynamic evolution information, the support of information is more and more important for the economic development. Information has become a strategic resource of economic development and the basic element of social management, and information technology (IT) has been a key to the development of human society and economic development. However, the success rate of information systems development project was low, and was difficult to be defined, since there were too many uncertainties in the process of IT projects. The main methods to eliminate uncertainties cannot avoid the uncertainties and improve the efficiency of the project drastically, because the subjective selection of human was critical for the efficiency of the IT project.

Real option theory was a popular method to deal with uncertainties in projects, and IT projects always brought new idea or new ways to do something, which can be called innovation. There was also theory for innovation adaption, which was well known as innovation diffusion theory.

This study will investigate the relations between real option theory and innovation diffusion theory, and also the effects of them on innovation adaption. Key questions which need to be asked are:

- Which types of real options will be considered to be utilized in IT innovation project?
- What are the key features of the innovation that can influence its adaption?
- What are the main components of the relationships between different types of real options and the key factors influencing innovation adaption?

2 THEORETICAL BACKGROUND

2.1 Real Option Theory

It was important to satisfy the human’s requirements as many as possible, or have potential to reach the needs to make an IT project completed successfully. If there was potential for the project to switch its usage, efficiency of the project can be increased, and the requirements were more likely to be reached. If a prototype of the IT project can be completed successfully before its full implementation, the uncertainties of the project can be avoid, and it was more likely to be successful. All of these potential or actions can be measured by the real option method, or thought from the option viewpoint. Real options, was developed by Stewart Myers (MIT) in 1977. The underlying security of the real option was a tangible good, not stock or futures. A real option was the right, but not the obligation, to take an action at a predetermined cost for a predetermined period of time. Real Options Theory (ROT) offered a way to accommodate for time progression and previously unknown factors. Unlike the more traditional techniques, real options theory explicitly accounted for future flexibility. The real options approach recognized the value of managerial flexibility. Such flexibility was important in situations dealing with structuring and timing investment decisions, especially in the face of uncertain conditions, varying levels of risks at different stages of an investment project, and irreversible investments. (Goswami, Teo and Chan 2008) Its utilization can increase the expected value of the IT project, and make the IT project easier to be successful for the organization to meet the users' requirements.

There were many different types of real options which had been studied in connection with specific IT investment risks, such as deferral option (Benaroch 2000), explore option (Kambil, Henderson and Mohsenzadeh 1993; Kulatilaka, Balasubramanian and Strock 1999), stage option (Benaroch, Shah and Jeffery 2005), change-scale option (Kulatilaka, Balasubramanian and Strock 1999; Gaynor and Bradner 2001), abandon option (Benaroch, Shah and Jeffery 2005; Brautigam, Esche and Mehler-Bicher 2003), outsource development and operations option (Lammers and Lucke 2004;
Whang 1992), lease option (Clemons 1991), and strategic growth option (Benaroch 2000; Taudes, Feurstein and Mild 2000; Zhu 1999), etc. The growth option considered the future growth opportunities that can be realized from an initial investment. The deferral option was the option to wait and delay an investment until more information arrived. The staging option was the choice of breaking up an investment into incremental conditional steps where each step was carried out after the successful completion of prior steps. The option to change scale had the flexibility to respond by altering the capacity. The option to switch had the ability to put the initial investment into an application different from what it was initially intended for. The option to abandon was the option to discontinue a project. The explore option was to give the right to create the prototype or pilot and to demonstrate the results, before the full implementation. (Brach 2003; Kogut and Kulatilaka 1994; Fichman et al. 2005; Tiwana et al. 2006; Tiwana et al. 2007)

2.2 Innovation Diffusion Theory

Normally, the product of an IT project was always new, and it can be treated as the innovation. The ways to diffuse the product and make it popular to be utilized were important. The popular usage was a measurement to judge the acceptance of the IT product by users and whether the project was successful. There was a mature model for the diffusion of an innovation, which was called Innovation Diffusion Theory (IDT). It can be utilized by the organization to measure whether the innovation would be successful or not.

There were five main factors which can influence the result, including relative advantages, compatibility, complexity, testability, and demonstrability (Rogers 1983). The factor of relative advantages indicated the superiority of innovation compared with the existing technology or product. If the innovation had obvious or absolute superiorities, it would be easier to diffuse the innovation, and the innovation can be adapted with less obstruction. The factor of compatibility indicated the degree of coexistence of the innovation with the existing moral values, previous experiences, and expected users' needs. If the innovation was more compatible, it would be easier for the innovation to be adapted. The factor of complexity indicated the degree of difficulty to understand and use the innovation. If it was less difficult to be understood and used, the diffusion would be easier. The factor of testability and demonstrability indicated the degree of difficulty for the innovation to be tested and for the results to be presented to the persons, on limited basis. If the testing and demonstrating were easier to be realized, the innovation would be more likely to be diffused. Once the innovation was adapted successfully, the users had accepted the innovation, which meant the project for the innovation was successful, at least at the customer level.

There were no relative researches on a combination model of both real option theory and IDT acting on the results of a project together, which was feasible theoretically. Utilization of real option theory in IT project can increase the expected value of the project by avoiding uncertainties, and IDT is a model explaining the factors on results of an innovation. Since IT projects always carry innovations, real option theory can help to avoid the uncertainties in innovation diffusion, through influencing the factors in IDT. The researches on this paper can make up the gap, and consider both real option theory and IDT in an IT innovation project systematically (See Figure 1).

```
\begin{center}
\begin{tikzpicture}
  \node[rectangle,fill=blue!10] (1) at (0,0) {Parametric Uncertainty};
  \node[rectangle,fill=yellow!20] (2) at (1,-1) {Real Option Theory};
  \node[rectangle,fill=orange!20] (3) at (2,-1) {Innovation Diffusion Theory};
  \node[rectangle,fill=purple!10] (4) at (3,-1) {Innovation Adaption};
  \draw[->] (1) -- (2);
  \draw[->] (2) -- (3);
  \draw[->] (3) -- (4);
\end{tikzpicture}
\end{center}
```

Figure 1. A Framework of Real Option Theory-Innovation Diffusion Theory Model.
2.3 Research Models and Hypotheses

The types of real options were multiple, and the effects on the factors in IDT were complex utilizing the original categorization. It was necessary to divide them into groups by a specific categorization. It was a reasonable categorization to divide types of real options by dealing with risks occurring in different stages in the investment lifecycle (Benaroch 2002). The main categories of the real options were building options which can be utilized for considering risks in the project-building stage, operation options which were utilized in the project-operation stage, and growth options in the project-retirement stage. No matter which stage the project is in, there are risks existing which may cause the failure of the project. However, if the options were considered, there were more methods to deal with or mitigate risks, and it would be less possible to suffer big losses from the risks. Considering real options to do decision should be positive to adapt an innovation project. The proposed model to combine both the real option theory and the innovation diffusion theory was indicated in Figure 2.

![Proposed Research Model](image)

2.3.1 Building Options

The building options mainly included explore options (including prototype options and pilot options), stage options, and lease options. All types of the building options emphasized to do a small-scale experiment to prove whether the innovation would be feasible in the future. If the results of the experiments were positive, it would go to the operation stage; otherwise, it can be stopped or dealt with in other ways. Therefore, considering the building options can improve the compatibility, reduce the complexity, and realize the testability and demonstrability. However, the relative advantages of the innovation from the building options were not consequent. Only if the results in the small-scale experiments period were positive, it was possible there were relative advantages for the innovation. Thus, the following hypotheses H1a to H1d were proposed:
H1a: the building options utilization has the positive influence on the degree of compatibility.
H1b: the building options utilization has the negative influence on the degree of complexity.
H1c: the building options utilization has the positive influence on the testability by creating small-scale experiments.
H1d: the building options utilization has the positive influence on the demonstrability of the results by creating small-scale experiments.

2.3.2 Operation Options

The operation options mainly included contract options, change-scale options, switch-use options, and abandon options. It indicated the options to have some actions when there were some risks or certain failures in the operation stage. If the current innovation can be utilized in some other places or points, the risks can be lower. So the relative advantages of the innovation can be improved, and also the compatibility can be improved. Since there were more than one ways to be utilized for the innovation, it was not consequent to reduce the complexity of the existing technologies or products. Thus, the following hypotheses H2a and H2b were proposed:

H2a: the operation options utilization has the positive influence on relative advantages to the innovation.
H2b: the operation options utilization has the positive influence on the degree of compatibility.

2.3.3 Strategic Growth Options

The growth options indicated strategic growth options. There was no necessary relationship between the strategic growth options and compatibility, complexity, testability, and demonstrability of the results. However, the further growth of the innovation can give more relative advantages, since it can add more values to the organization and the society. Thus, the following hypothesis H3 was proposed:

H3: the strategic growth options utilization has the positive influence on relative advantages to the innovation.

2.3.4 Innovation Diffusion Theory to Innovation Adaption

As shown in previous researches, the five factors including relative advantages, compatibility, complexity, testability, and results demonstrability can influence the adaption of the innovation (Rogers 1983). Thus, the following hypotheses H4a to H4e were proposed:

H4a: increasing relative advantages has the positive influence on the innovation adaption.
H4b: improving compatibility has the positive influence on the innovation adaption.
H4c: reducing complexity has the positive influence on the innovation adaption.
H4d: if it was easier to test the innovation, the innovation adaption can be influenced positively.
H4e: if it was easier to demonstrate the results of the innovation, the innovation adaption can be influenced positively.

2.3.5 Parametric Uncertainty

The main contribution of the real option theory utilization was considering the growth and flexibility of the IT project, which can be affected by uncertainties in the project. Therefore, the amount of
uncertainties included in a project can influence the effect of the real option theory on the factors of the innovation diffusion theory. The following hypotheses H5a to H5g were proposed:

H5a: parametric uncertainties have positive moderate effects on the influence of building options on results demonstrability.
H5b: parametric uncertainties have positive moderate effects on the influence of building options on testability.
H5c: parametric uncertainties have positive moderate effects on the influence of building options on complexity.
H5d: parametric uncertainties have positive moderate effects on the influence of building options on compatibility.
H5e: parametric uncertainties have positive moderate effects on the influence of operation options on compatibility.
H5f: parametric uncertainties have positive moderate effects on the influence of operation options on relative advantages.
H5g: parametric uncertainties have positive moderate effects on the influence of the strategic growth option on relative advantages.

3 METHODOLOGY

A survey will be conducted to collect sample data to examine the proposed research model. The sample selected for the analysis will be some appropriate IT innovation project, which are useful to validate the proposed model. The methods utilized include the descriptive statistics methods to deal with the raw data from the survey, and the statistical inference methods (i.e., Partial Least Squares method) to prove the hypotheses above.

The measurements included in the questionnaires for the survey will be adapted from the research literature. As well, there were variables which can affect the result whether to adapt the innovation or not, except the consideration of the options. They can be set as the moderator variables and the control variables. In this research, parametric uncertainty was treated as the moderator in the model, and the control variables considered in the model included project size, organization culture, CEO support, and champion.

4 EXPECTED CONTRIBUTION

This research aim to create a model, which can be utilized to improve the adaption rate of IT innovations. The main contribution of the proposed model is considering the growth and flexibility of the IT innovation project. Since it has potential to grow, it would be easier to adapt the innovation. The consideration of flexibility can help to measure an innovation more completely. It is a better model to select the IT innovation project and to consider its future development. In addition, previous researches always study the effects of considering real options on the innovation adaption directly. However, this research tries to prove that the effects are not direct, while there are mediators between the effects of considering real options on innovation adaption.

References


