

# Decision-making Model and Risk of R & D Outsourcing Based on Supply Chain in IT

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**Abstract**— With the development of the computer technology, the R & D outsourcing is becoming more and more popular for the company area. This paper presents the decision-making model and risk of R & D outsourcing based on supply chain in IT, it discusses the phenomenon of the R & D outsourcing in IT market and explores the R & D outsourcing model and decision-making in the technology uncertainty, the radical innovation and the market uncertainty dimension, at the same time, it analyses the moral hazard and the technology risk faced by the R & D outsourcing under different risk scenarios in the computer area. And this paper can provide the decisions for the R & D Outsourcing in the IT industry.

**Keywords**-R&D outsourcing;decision-making model; risk; uncertainty; radical innovation

## I. INTRODUCTION

Along with increasing of the technological uncertainty and the development cost, the enterprise has begun to pay attention to a product the revenue sharing, the cost sharing or the technical buying and other forms of the R & D outsourcing instead of the independent technology research and development. Matthew, Rodrigue(2006)from the perspective of the resource-based theory, they interpreted “R&D outsourcing” as a way of the enterprise uses merger and acquisition way in the computer, which is an effective supplement to the internal R&D and cooperative R&D, namely the enterprise when the internal resources are limited, retain only the most competitive resource, at the same time to integrate the external resources to achieve the synergy effect[1]. Chiesa, Manzini (1998) from the relationship-contract theory, they interpreted “R & D outsourcing” as one party funding, with the contract entrusted to another party such as the external research institutions with the new products, the new technology or the new ideas and the technological achievements[2].

Jeroen P.J. De Jong (2007) investigated 288 enterprises and 317 service enterprises in the computer area, they found that 59% and 43% enterprises adopt the R & D outsourcing. Outsourcing is the high-end segment in the service outsourcing[3]. PalmOne employs a mixed mode of the internal R&D and outsourcing R & D combination. PalmOne used the ODM manufacturer exclusive cooperation mode, which can use the existing hardware platform, to customize the silicon or display, and can put main energy in the software development, make the products more characteristics. Lucent Technologies outsourced most of the manufacturing outsourcing to EMS.

EMS is designed to work in partnership to bear more and more lucent, mainly relates to a mature product cost cutting and life cycle management, also participate in the development of new design.

The R & D outsourcing emphasis on how to deliver value through the effective cooperation in the computer, involving the contract in the process of the cooperation, the contract should be selected by R & D outsourcing model and its risks [4]. In this paper, we mainly discuss the phenomenon of the R & D outsourcing in the computer area and explore the R & D outsourcing model and decision-making in the technology uncertainty, the radical innovation and the market uncertainty dimension in the computer, analysis the moral hazard and technology risk faced by the R & D outsourcing under the different risk scenarios.

The steps of the synthetical evaluation can be defined as follows, the frame of which is showed as Fig .1 [5].

- Carving the whole project up to the different stages, recognizing corresponding risk types;
- Structuring probability IDs according to different stages and risk types, simplifying the models;
- Collecting data, evaluating the influence diagrams;
- Evaluating these influence diagrams synthetically.

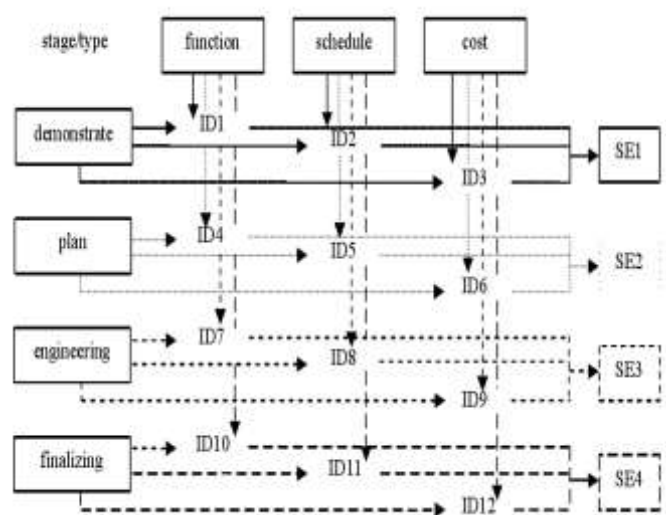


Figure 1. Frame of R&D project supply chain risk conductive evaluation

## II. THE REASONS OF R & D OUTSOURCING EMERGED IN THE IT INDUSTRY

Why the R & D outsourcing is emerged in the computer area? As far as people think in the past, the development was the life of the computer enterprise, the computer enterprise needed only to bring forth the new ideas in order to maintain their youth, so it was unthinkable if they gave the development to the others to do.

But now more and more the computer enterprises realize that their profit can be derived from the customer's loyalty to their brand, or the supply chain management which are better than the other companies. And not just dependent on the product research and development continuously in the computer enterprise. Though the R & D outsourcing of the computer bring the profit to the enterprises, at the same time, they also are faced with a lot of problems, so that the enterprises have to make the trade-off whether or not they need to complete the work of the research and development by themselves.

First, because the information technology becomes more and more extensive and complex, the enterprises may not allocate the comprehensive technical personnel, to engage in their own work in the IT enterprises.

Then, because the IT facilities are a few and limited compared with the whole IT industry in the enterprise, it is difficult to retain the first-class technology talents in IT, so that the specialization and enthusiasm of the technical personals is not enough, and the space is too small to display.

Finally, the professional IT enterprises are very strict to their management, so is difficult for the enterprises to do the same to manage their own technology talents compared with the professional IT enterprises,

Due to the above reasons, many IT enterprises invest a lot of resources and cost, but they do not get the enough return, and much work is inefficient, which will result the core business is provided the strong support and guarantee.

## III. DECISION-MAKING MODEL OF THE R&D OUTSOURCING

Balachandra and Frica (Balachandra, Frica, 1997) found that the R & D outsourcing decision in the computer (whether the R & D outsourcing, what the manner of the R & D outsourcing), need to be make in a certain environment [6]. So this paper describes the analysis model for decision making on the outsourcing behavior of the R & D, that all research and new product development project can be divided into three dimensions: Market (new or existing market), technology (familiar or unfamiliar technologies) in the computer, innovation (incremental innovation or the breakthrough innovation).

### A. Consider technical uncertainty in the IT industry

With the rapid development of information technology, the Information technology is became also more and more uncertainty, so it is easy to be replaced. The function of the information technology is stronger than before, but the cost of the equipment is decreasing, when an enterprise is signing the contract, it cannot anticipate all changes of the IT technology in the future. If the application of the new technology has the important significance but the original contract did not write the type of this change, it will bring

the great uncertainty of the R&D outsourcing in the IT industry.

Technology uncertainty of the computer has great influence on the R & D activities. Technology includes all the theoretical and practical knowledge, skills, production and supply chain systems which used to enterprise value chain creating activities. Technology has two main aspects of the uncertainty, that is the technical transformation uncertainty and the uncertainty of the time used by the technical transformation.

1) *Technical transformation uncertainty of the IT industry*: In the initial stage of technology development process of the computer, when the investment decision has to be made, they have only an estimate of the effect of new product. The estimated values influence new product development degree, that's to say a product R & D effect is uncertain. At the same time, even if the enterprise can improve the quality of the final products through the accumulation investment, but innovation triggered by accumulated investment can be transformed into market consumer acceptance of products is uncertain[7]. It represents the ability of the translation of good ideas into commercial value.

When the technical transformation uncertainty of the computer is high, Internal R&D is usually more suitable; on the contrary, when the technical transformation of uncertainty is low R & D outsourcing is more suitable.

2) *The uncertainty of time used by technical transformation of the IT industry*: Technology development time of the computer often depends on the R&D capability of enterprises and the objectives which the products expected to achieve. A new technology especially complex technology has many unpredictable factors directly affect the development process in the development process, so the technology development time is uncertain. Owing to the project has life cycle and time cost, so the development time uncertainty directly of the computer affects the R & D outsourcing decision.

Influence of technological uncertainty on the R&D outsourcing in the computer is complex. It with R&D outsourcing model (such as a payment technology outsourcing, investment cost sharing form, innovation work sharing form) and the relative technology levels of R&D demand side and supply side [8]. But the general trend is the decision influence on R & D outsourcing displays a "U" - shaped trend [9], when the technological uncertainty rising in the computer, enterprises will adopt more R & D outsourcing strategy, but when uncertainty rises to a certain height leads to the degree of information asymmetry to a higher level, the enterprise may tend to adopt the internal R & D.

### B. Consider the extent of radical innovation in the IT industry

According to the degree of radical, innovation can be divided into incremental innovation and radical innovation in IT. Incremental innovation can be viewed as accumulated, continuous partial or improving innovation activities. This change in innovation of the computer is based on the existing technology and existing production capacity, and is linked to changes in the existing markets

and customers. Incremental technology innovation product progressive includes refinement, improvement and upgrading the existing products, production or distribution system. Incremental technological innovation of IT is based on persistent technology, is to enhance and improve products and services from the majority of users are concerned about the main market.

Radical innovation of the internet is a higher level of innovation. It has changed the technological process of the company, and creating a new industry, product or market. Radical innovation or product innovation is more obvious than the incremental innovation or process innovation in the outsourcing relationship.

### C. Consider the uncertainty of the market in the IT industry

The uncertainty of the market can be divided to the uncertainty of product and yield uncertainty in IT. Uncertainty of product manufacturing varieties relatively uncertain or manufacturing process changes frequently, also means that the manufacturing process more uncertainty in the computer. Products or services may have a greater degree of uncertainty, and is not conducive to the outsourcing services. The output uncertainty tends to determine the outsourcing service demand uncertainty. Output volatility, or yield fluctuation does no rules to follow, will increase the cost and difficulty of outsourcing.

Overall, if enterprise's R & D behavior of developing new products based on the existing market in IT, and R&D behavior is incremental innovation business of the computer, then the R & D outsourcing behavior is easy to outsourcing. This kind of outsourcing tasks are programmed, can carry out budget based on the cost and time, and can manage it by non-cooperative partnership. If the enterprise to develop new products R & D behavior in the existing market, but the research and development of new products and technology are not familiar with this technology innovation may be sudden, then R & D best done by enterprises themselves, the project because of budget and time schedule uncertainty in the computer area, so it needs more flexible management.

## IV. THE RISK OF R&D OUTSOURCING IN THE IT INDUSTRY

Because the uncertainty of the R&D outsourcing in IT is more and more serious, and the management is becoming more and more complex, the range of the function is more and more wide, the number of the money is more and more large, the term is more and more long, which will result the risk is also became inevitable of the R&D outsourcing in IT.

For example, the risk out of control: Many IT enterprise is doing the R&D outsourcing, the customer will become dependent on the contractors of the R&D outsourcing inevitably, and the customer is unable to manage these contractors which is similar to management their own internal organization, therefore, they are no way to monitor and control these contractors. Timeliness, the service quality and the service cost provided by the contractors of the R&D outsourcing are involved a great deal of risk, and the confidentiality and the intellectual property also may be let out.

As the above analysis, the outsourcing behavior research of the computer industry faces to many risks due to many uncertainty of R&D outsourcing. Only understanding of these risks deeply, we can goodly avoid these risks of the computer. Then we will mainly discuss the existence of moral risk and technology risk of R & D outsourcing in the computer industry.

### A. The moral risk of R&D outsourcing in the IT industry

The process of R & D outsourcing involves many stakeholders, among the stakeholders there have a principal-agent relationship, so incomplete information and asymmetric information will bring a series of risk to the R&D outsourcing.

1) *The risk caused by opportunistic behavior in the IT industry* : On the macro level, imperfect technology market and imperfect legal punishment mechanism in IT will increase the risk of moral hazard. On the micro level, risk sharing, selection of partnership, uneven income distribution and lack of motivation also can lead to moral hazard.

2) *Cross subsidization of project in the IT industry*: The R & D projects in IT especially with a high degree of complexity and uncertainty of R & D projects, because of can't state the exact nature of innovation, which will lead to a very common problem of moral hazard, namely cross subsidization of project. Cross subsidization project fully reflects the moral risk of supply side R & D activities in incomplete contract conditions. Specifically, when the supply side development project of the demand side of the R & D project in IT, due to the existence of multiple objectives of supply side, It will take advantage of the demand side of the funding for research and development project, Or will the key provisions in the contract in advance of R & D personnel involved in the project configuration to other R & D projects.

3) *Disclosure of information in the IT industry* : The Information disclosure is further reflected incomplete contracts in the R & D outsourcing context in IT. R&D outsourcing process needs partners share information, but at the same time can cause information disclosure. Information disclosure in two ways: one is the disclosing party can disclose information to competitors of his partners; the two is directly enter the industry of partners as competitors. Information disclosure can reduce the R & D project demand market share, resulting in great economic losses.

### B. Technology risk of R&D outsourcing in the IT industry

R & D projects, especially in the development of new products and new technology with high risk characteristics in the IT industry, among them technical risk is the main risk in R & D activities [10]. In recent years, accelerating technological change make the uncertainty of R & D is more and more big. The product development and Management Association (PDMA) studies, the current new product development success rate only 59%, a report of America National Institute of standards and technology display in IT, large dedicated software development failure

rate is as high as 70%. Increase technical risk also has a great influence on the R & D outsourcing.

With the rapid development of the R&D outsourcing in the IT market, it is necessary to analysis the risk. Strategic innovation aims at a re-conceptualisation of business models, the creation of uncontested market spaces, and leaps in customer value [11]. From the point of the customer, we can find out some kinds of the risk are existed in the IT market, even containing some serious risks, so it is very important to monitor these risks and manage them all the time. By focusing on the main risks and finding the reasons of these risks how to produce and how to find them, we can set up the analysis frame of the risks for the customers much usefully in the IT market of the R&D outsourcing. The enterprises must cultivate an ability to encourage the customers of the R&D outsourcing, and they need to ensure that the enterprises get what they want. The enterprises must also learn to manage the whole transaction after signing the contract, this way can ensure that the enterprises are the master of their own fate in IT, which can obtain the service and added value effectively provided the providers of the R&D outsourcing in the IT market.

## V. CONCLUSION

In the new economic situation, R&D outsourcing is a new strategic that can help enterprise to get technology acquisition and technology innovation. This paper mainly discusses the R & D outsourcing mode and risk caused by it. First of all, according to Balachandra on the R & D outsourcing mode on the basis of the technology uncertainty in IT, market uncertainty, and extent of radical innovation. We further study of the R & D outsourcing model of the R & D outsourcing decision-making influence. Secondly, in the context of the R & D outsourcing, transaction sides facing much risk in IT, we discuss theses.

So the IT enterprises can share the risk by using the R & D outsourcing mode, and save the cost and shorten the development cycle, which can make the products take the lead fast. And more and more companies tend to seek the source of the technology from the outside, in order to achieve the resources reasonably and enhance the competitive power of the enterprises.

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