Risk sharing of construction projects based on IPD

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Abstract

There are some researches on the IPD (Integrated Project Delivery) mode both at home and abroad, but the research on risk sharing of IPD construction projects is less. This paper started with risk identification, and divided the responsibility risk of participants by risk classification. The risk sharing of IPD construction projects and the risk sharing process are discussed.

Keywords

Integrated Project Delivery; risk factor; risk classification; risk sharing.

1. Introduction

With the construction of the continuous development and technological innovation, the three goals of time, cost, quality have been unable to meet the needs of the project team. To achieve maximum project value and to make the project participants to gain common profit have become the biggest demand. Because of the "opposing" relation between their participants in traditional delivery mode, owner and contractor mutual transfer risk by means of change notice or claim letter. This has caused the extension of time or cost of waste and other issues, and the project cannot achieve the maximum value. It is proved that IPD (integrated project delivery) model is a project delivery model which can integrate personnel, system, knowledge, experience, able to reduce waste and reduce costs, reduce rework to shorten the construction period, and enhance the value of buildings for owners[1] .

IPD model has a lot of benefits, but because the participants do not trust each other, unwilling to take risks, few IPD projects success in China. This shows that reasonable sharing of project risk is the key to the success of IPD mode.

2. Research at home and abroad

2.1 Research abroad

2.1.1 Research abroad on IPD

In the late twentieth Century, the prototype of the IPD first succeeded in BP (Petroleum British) company's UK North Sea oil drilling platform project. Then it succeeded in the National Museum of Australia projects and Sutter County, California comprehensive health project. Since then the industry began to recognize and accept the IPD mode2. At present, the IPD mode is gradually developing, and it becomes a kind of building project delivery mode which has a clear and exclusive contract system. The US and Australian governments, the American Institute of Architects, the general contractor associations, and professional companies which have greater influence in the industry have been released the relevant definition of IPD.

2.1.2 Research abroad on risk

So far, a lot of foreign scholars have carried on the research to the project risk. Vega (1997) considered project risk-sharing model is not fixed, and the corresponding results are not the only one. He stressed every Project's environment is different, so risk-sharing of project should be based on the project's own specific circumstances. Martinus proposed risk sharing of meaning: a reasonable risk sharing mechanism includes determining which side to take what kind of risk and the best time to share risk,

and provides a variety of risk sharing schemes. On the basis of this, the principle of risk is also presented. It mainly includes: participants must be willing to take risks, all participants must correct recognize and evaluate various risk correctly; the risk should be borne by the most controlled party; participants must have the ability of technology and risk management; participants must have the economic ability to bear risk consequences or prevent the occurrence of risk 3.

2.2 Research at home

Most domestic scholars have stayed at the concept study phase of IPD research. Their research mainly summarized the advantages of IPD, and the development prospects and barriers of IPD in China by comparing the IPD mode with the traditional delivery mode. In addition, most scholars focused on the collaborative application of BIM technology and IPD model. The research team led by Zhang Lianying, in the aspect of cost control, has analyzed the current status of IPD development and the current IPD standard contract, and has proposed the advantages of IPD mode. On the problem of applying IPD to engineering projects, Zhao Xu, Zhang Lianying, through comparison of IPD model and traditional project transaction mode, have summarized its characteristics and application process, and have studied the evolution of IPD from three aspects: the integration process, contract and BIM technology.

Throughout the domestic and foreign literature, the research on risk sharing of IPD mode is less. So this study provides a reference for the study of IPD risk sharing, and it is of great significance for the development of IPD in China in the future.

3. IPD Project Risk Identification

3.1 IPD Project Risk Classification

Risk identification is a systematic and continuous prediction and classification of the risk factors of the project itself, which may affect the project objectives. It is usually before the risk of an accident, and can identify the risk factors that may induce risk event develop to risk accident4. In order to share project risk effectively, it is necessary to identify the potential risk factors before the implementation of the project. For IPD project risk identification, according to the academic community generally recognized Li.B.et al(2005) classification method5, this paper classifies the risk of IPD project from the macro, meso and micro by the system boundary. Specific relationships are shown in figure 3-1.

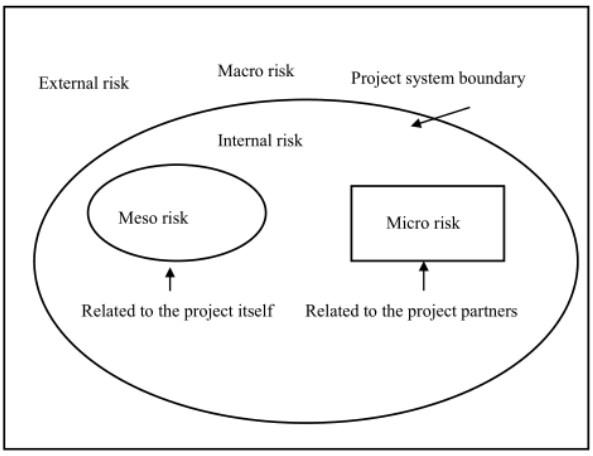

Figure 3-1 risk level classification structure diagram

Macro risk

The macro level risk is the social forces that threaten the project activities. These risk events are not due to the project itself, but impact the project through the project boundaries. These events affect the project itself through external changes in the project. The main concern is the state, industry and natural environment and other changes to the impact of the project, such as natural environment, political conditions and so on. In this paper, the risk of macro level is divided into four major categories: natural environment, law, market and politics.

Meso risk

The meso level risk is the uncertainty caused by the project itself, which is caused by the change of the project system. This paper from the whole life cycle of project decision, design, construction, operation and maintenance and discard recovery the five stages to identify the medium level of risk.

Micro risk

The micro level risk refers to some risk events which caused by human relations in the process of whole life cycle. This kind of risk is the internal risk of project system, but it is not related to the project itself. The micro level risk can be identified from the relationship between the participants, including the new risk, communication risk, responsibility allocation and lack of experience.

3.2 IPD project risk factor set

Learn from risk classification method of financing projects, the risk factors of IPD project were analyzed by the method of decompounding risk factors, and the risk factors set was set up, as shown in table 3-1. For the convenience of the participating party liability and related risk management, risk factors set were classified based on the principle of "mutually exclusive and exhaustive". Risks of IPD project were divided on basis of the classical criteria of risk classification: macro, meso and micro levels. Because a risk may occur in the different phases of the project life cycle, there is no use in accordance with the time series to risk classification and avoid the repeated risk items. The ultimate risk set of the IPD project was divided into 10 kinds of risk, which was divided into 36 risk factors, as shown in table 3-1.

4. Risk sharing of IPD project

4.1 Risk sharing principle of IPD project

Risk Sharing

Risk sharing of IPD project can be understood as sharing risk loss. In the project, the manager should take the IPD contract system as the center, combine with the actual engineering situation, regard the project overall risk management optimization as the goal, clear the parties should identify and manage the risk.

Risk preference

In the process of identifying risk, we must take full account of the cost of participating parties' ability and management risk. In order to improve the project's overall revenue and reduce risk cost, the parties involved in the IPD prefer to take risks for which they have a strong prediction, management and control.

Risk and return peer

The basic principles of IPD model are revenue sharing and risk sharing together. So the more risk the participants take, the higher the return.

(1)All the participants share the project's total revenue;

(2)The income of the participating parties is proportional to the amount of risk sharing;

(3)The income of the participating parties is proportional to the amount of investment;

(4)Risk and control peer.

The principle is that risk sharing should be proportional to the risk control ability. That is which party can identify and manage the risk well , the risk is shared by which side6. This principle is the most basic risk sharing principle in the world, and it is also observed in IPD mode. This ensures that the risk takers can most effectively predict and control risks, to achieve the aim to reduce the risk loss and risk cost. According to this principle, some uncontrollable risk can be transferred to third-party insurance companies.

Table 3-1 IPD project risk factor set

Risk Level	Risk Factors Group	Risk Factors Code	Risk Factors name
Macro risk	Political risk	R1	Risk of political unrest
		R2	Risk of government/public opposition
		R3	Risk of government approval delay
	Legal risk	R4	Risk of engineering change and imperfect law on IPD
		R5	Risk of construction industry regulatory changes
		R6	Risk of policy change
	Market risk	R7	Risk of low efficiency of financial market
		R8	Risk of inflation rate
		R9	Risk of interest rate fluctuation
		R10	Risk of Exchange ratio change
		R11	Risk of market demand
		R12	Competitive risks of similar projects
		R13	Labor / materials and equipment prices risk
	Natural risk	R14	Uncontrollable risk
		R15	Risk of climate conditions
		R16	Risk of geological conditions
Meso risk	Decision phase	R17	Risk of cooperation feasibility
		R18	Risk of project participants' less attractive
		R19	Risk of selection of participants
		R20	Risk of high cooperative cost
	Design phase	R21	Risk of design quality
		R22	Risk of BIM technology
		R23	Risk of design change
	Construction phase	R24	Risk of examination and approval
		R25	Risk of construction process
		R26	Risk of construction safety
		R27	Risk of construction delay
		R28	Risk of construction cost overruns
		R29	Risk of unqualified Engineering quality
	Operation and maintenance phase	R30	Risk of high operating and maintenance costs
		R31	Risk of insufficient income
	Disposal recovery stage	R32	Residual risk
Micro risk	Cooperative relationship risk	R33	Trust risk
		R34	Communication risk
		R35	Risk of allocation of responsibilities
		R36	Risk of lack of experience

4.2 Risk of responsibility for each participant

According to the principle of IPD risk sharing, the most control party is to carry on active management to the risk. IPD contract is a relational contract. It is not the focus of the final product, but to consider the contract process[7]. At the beginning, the definition, composition and distribution of the risk should be more detailed in the IPD contract[8]. Use for reference from the division of project risk responsibility under the contract management mode of our country[9-12], the responsibility and obligation of the parties to manage risk are clarified , so that each party has a certain risk responsibility. The risk management of the participating parties is shown in table 4-1.

4.3 Risk sharing process design

Table 4-1 IPD project Liability Risk Management Table IPD of Each Participant

Code	Participants / Risk	Owner	General contractor	Designer	Consultant	Supplier	Insurance company
R1	Risk of political unrest	●	○				
R2	Risk of government/public opposition	●	○				
R3	Risk of government approval delay	●	○		○		
R4	Risk of engineering change and imperfect law on IPD	●	○	○			
R5	Risk of construction industry regulatory changes	●	○	○			
R6	Risk of policy change	●	○				
R7	Risk of low efficiency of financial market	●				○	
R8	Risk of inflation rate	●				○	
R9	Risk of interest rate fluctuation	●				○	
R10	Risk of Exchange ratio change	●				○	
R11	Risk of market demand	●			○		
R12	Competitive risks of similar projects	●			○		
R13	Labor / materials and equipment prices risk	○				●	
R14	Uncontrollable risk	○					●
R15	Risk of climate conditions	○					●
R16	Risk of geological conditions	○					●
R17	Risk of cooperation feasibility	●			○		
R18	Risk of project participants' less attractive	●			○		
R19	Risk of selection of participants	●			○		
R20	Risk of high cooperative cost	●			○		
R21	Risk of design quality		○	●			
R22	Risk of BIM technology		○	●			
R23	Risk of design change	●	○				
R24	Risk of examination and approval	●					
R25	Risk of construction process		●	○			
R26	Risk of construction safety		●				○
R27	Risk of construction delay		●				
R28	Risk of construction cost overruns		●			○	
R29	Risk of unqualified Engineering quality		●				
R30	Risk of high operating and maintenance costs	●		○			
R31	Risk of insufficient income	●					
R32	Residual risk	●		○	○		
R33	Trust risk	●		○	○		
R34	Communication risk	●		○	○		
R35	Risk of allocation of responsibilities	●		○	○		
R36	Risk of lack of experience	●		○	○		

Attention:1. ●represents to take major risk, ○ represents to take minor risk；
2. Above risk allocation results represent only a certain kind of risk allocation, which is caused by the general situation.

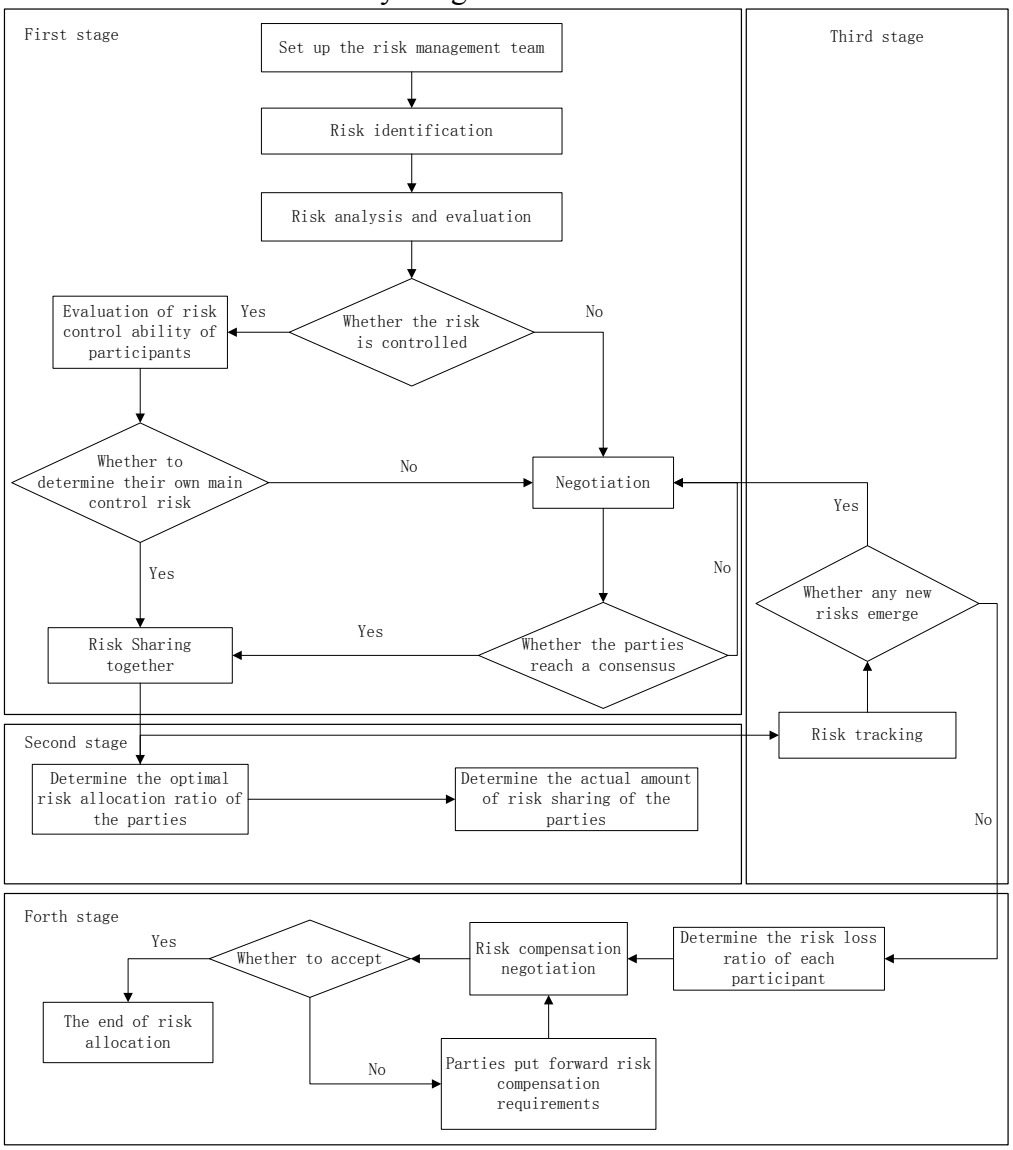

Figure 4-1 Flow chart of risk sharing

Because of the Uniqueness and complexity of the project, the allocation of the risk management of the parties is effective under the conditions of the parties concerned. If the allocation of some risks which some participants disagree, or specific risks of the project exist, the risk allocation of IPD project will become complicated. Determining the actual project risk-sharing scheme cannot depend on one meeting, which cannot get a satisfactory result for all parties. Making reference to the risk sharing mechanisms of which have developed mature in our country, such as PPP[13-15] , BOT[16,17], BT[18], and taking into account the risk preferences and risk control ability of the participants, the risk sharing process is constructed, which is based on multiple negotiation and negotiation. In this paper, the risk sharing process of IPD mode is divided into four stages, as shown in figure 4-1.

First stage: This stage is the initial stage of risk-sharing, and participants work together mainly for their own risk allocation. The prophase, after determining that the project fit and deciding to adopt the IPD model construction, detailed feasibility studies and risk identification should be carried out. A risk management team is set up from all parties. This team identifies the risk factors of project characteristics as far as possible, combined with the advice and suggestions of the participants in their own professional point of view, and makes a preliminary analysis of identified risks.

Risk allocation at this stage can be divided into three steps. Firstly, in primary distribution, the management team classify risks within the capacity of the parties can be effectively controlled .Next, it is risk redistribution time. The team classifies potential risks and incontrollable risks. Finally, for both controllable risk factors, the participants decide whether to allocate the controllable risk according to the above risk management allocation table, based on assessment of the ability to control their own risk management. If the parties have not accepted the assignment, or one of the most control parties is not in agreement with the main management risk in table 4-1, the parties shall negotiate in a negotiation. If the parties still cannot consensus, risks reserved for the second phase of the redistribution.

Second stage: The main task of this stage is to determine the optimal risk allocation ratio of the parties. According to preference or aversion to risk parties involved, to reduce the total risk loss by transferring risk among the participants, and determine the ratio of transferred risk. Risk-sharing amount determined at this time is the actual amount shared for all parties.

Third stage: This stage is a stage of dynamic management of risk, requiring tracking and allocation of risk again. In view of the complexity and protracted nature of the project, in the whole life cycle of project, risk management team tracks the risk and finds the difference between the results of risk, while monitoring whether the emergence of new risks. If so, then go back to the first stage of risk allocation again, until the end of the project.

Forth stage: It is an allocation stage of the risk loss, at the same time which must be summarized and assessed. In the first step, the risk cost is settled in the final stage of the project. At the same time, according to the principle of risk and return peer, risk sharing ratio and risk loss of each participant must be determined. In the second step, risk assessment team t assesses the value of the participants. According to the risk they should bears and actual burden, the project gives the corresponding compensation. In the third step, according to their actual risk of the project, the parties make a decision of compensation requirements. If accepted, the risk distribution end, if not accepted, the parties renegotiate until all satisfied.

5. Conclusion

After studying the data of IPD model in China and abroad, this paper puts forward the risk sharing framework of IPD model in line with the situation of our country.

1. This paper fully studied the characteristics of IPD model. According to the classification of Al Li.B.et (2005), the risk was classified from three aspects: macro, meso and micro. Taking the whole life cycle of the project as an angle, combining the case of similar projects, 36 risk factors were identified, and the risk factor set was summarized.

2. According to IPD risk sharing principle and the most control principle, from the perspective of participants, the responsibility and obligation of the parties involved in the management were defined, and the risk management table of the participants was summarized.

3. Because of the complexity and the protracted nature of the project, the risk allocation of IPD project becomes complicated. In the practical engineering, the satisfactory results of the risk sharing for participants cannot be obtained readily. So, on the basis of the risk appetite and risk control ability of participants, the risk sharing framework based on multi negotiation was constructed.

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