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Study on the Influence Factor System of Engineering Project Schedule in Construction Supply Chain Model

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Abstract: The uncertain factors influencing the whole schedule of construction supply chain and the uncertain factors of the enterprises in influencing the schedule in each panel point are analyzed. Based on the analysis of influencing factors made by the ISM method, two aspects are generalized: The extent of the cooperation consciousness of the strategic partner (information sharing) and the handover of each professional process.

Key words: Influencing factors, construction supply chain, ISM

INTRODUCTION

The construction industry in China is a massive and complicated system, in which each participant will try to seek the largest economic benefits possible. Therefore, it's very hard to coordinate so that the time will be delayed and economic losses will be caused. The supply chain provides the manufacturing enterprises with huge economic benefits and improvement of productivity; it also offers reference value for the construction industry. In the model of construction supply chain management, factors influencing the schedule of engineering project are various due to the large number of participants. Therefore, it is necessary to form systematic engineering project schedule influencing factor system in a certain way based on the analysis of factors influencing the engineering project schedule, in order to provide basis for the management of project schedule in the model of construction supply chain.

ANALYSIS OF FACTORS INFLUENCING THE PROJECT SCHEDULE IN THE MODEL OF CONSTRUCTION SUPPLY CHAIN

Uncertain description of the factors influencing the whole schedule of construction supply chain: In the model of construction supply chain, the uncertain factors influencing the whole schedule of the supply chain include:

- The stability of the strategic partner of the construction supply chain

Currently, our country is in the process of rapid development of infrastructure and strengthening the investment of fixed assets. There are a number of main bodies in the participation. As 'rational economists', these main bodies will not be satisfied with a fixed project; instead, they are 'benefit-oriented', seeking for the largest extent of benefits (Love *et al*., 2004). Besides, different kinds of projects may put forward different demands for the project partners. There factors create instability among the strategic partners of the construction supply chain so that the whole schedule is affected.

Extent of cooperation awareness of the strategic partners: Currently, the strategic cooperation partners in the construction supply chain are still in the primary stage. The cooperation awareness of the main bodies in the construction markets, as part of the construction supply chain, is still quite weak. It is still in the stage of 'working separately on the same platform' to a large extent, especially in terms of information sharing. Both the hardware construction and the software construction of information sharing are not mature enough. The strategic alliance carried out when the cooperation consciousness lacks, the unity and integrity of the work are bound to be influenced (De Leeuw and Volberda, 1996).

Coordination of the strategic partners: The fundamental purpose of construction supply chain is to maximize the construction efficiency of the project by coordinated and uniform action (Voudouris and Consulting, 1996). However, there are some differences in the management model, acquired behavior and standard of conduct, which cannot be solved by the construction of strategic partner's alliance. This results the lack of coordination between strategic partners, which affects the management of schedule.

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Climate conditions: Since the climate is uncertain, it brings difficulty to the storage of construction and installation of materials and will affect the normal conduction of the whole plan, which is worthy of consideration.

Description of uncertain factors of the enterprises in influencing the schedule in each panel point: The participants of the construction supply chain, that is, the panel point enterprise, include: The proprietor (investor), the agent, the supplier, contractor (subcontractor) and the retailer.

Main influencing factor of the proprietor (investor): In the schedule is the problem of capital. The conduction of the construction schedule plan must involve capital. If the materials cannot be conveyed or the wage cannot be paid due to deficiency in capital, the project schedule will be affected seriously (Duclos *et al*., 2003).

The main influencing factors of the agent (including the designer and the supervisor) include design changes and the survey on materials. In the process of the project, the requirements of the proprietor may change, resulting to the changes of plan. It disrupts the original plan, increases the volume of the project and causes delay. If the design unit cannot provide design draft on time or the draft is unqualified, it will exert great influence in the project. In addition, when prospecting the terrain, large errors may cause due to the limits of the field condition, resulting the redesign of the general drawing and the delay of time.

The main influencing factor of the supplier lies in communication and coordination. The construction materials and equipment should be supplied on time so that materials and equipment are guaranteed for construction. If the supplier cannot provide materials or equipment on time, the construction period and the enthusiasm of the staff will be affected (Milner and Kouvelis, 2005).

The effects that the contractor (subcontractor), as the core enterprise in the construction supply chain, faces are the conditions of the construction site, the handover of each professional process and the coordination between each panel point enterprise. If the construction site provided by the proprietor cannot meet the demands of the construction, for instance, if the project locates in the remote and bleak area or the construction sites is far away from downtown or even in the mountainous area, each affiliated facility has to start from scratch. If the proprietor assumes part of the facilities or if the power supply is not ready, the construction cannot commence (Yeo and Ning, 2002). Meanwhile, the general contractor has to undertake the coordination problem between each panel point enterprise in the construction supply chain, making the handover of each profession and process clear. Each profession should coordinate with each other and make changes according to the changes of each plan, equipment, electricity, dewatering and fire control and air-conditioning project. Each profession should coordinate with each other and take care of each other without interference.

ANALYSIS OF THE FACTORS INFLUENCING THE PROJECT SCHEDULE IN THE MODEL OF CONSTRUCTION SUPPLY CHAIN BASED ON THE ISM METHOD

The model of construction supply chain is an integral system. When this system conducts schedule management, it encounters many uncertain problems. These influencing factors must be analyzed so long as to improve the system to handle the flexibility of the uncertainty. The relations between these factors cannot be understood by the managers clearly. Therefore, the adoption of ISM Interpretative Structural Modeling (ISM) method can help the managers to analyze the relations between these factors influencing the schedule in the model of construction supply chain and their extent.

Description of the problem and the selection of the target: In the actual construction, the project schedule is mainly affected by the factors mentioned above. The analysis of these factors and the discovery of the main influencing factors are of great significance to the implementation and control of the schedule plan. In order to study a system, the interrelation between the factors in this system must be understood firstly, that is to say, the structure of the system or the structure model to establish the system should be known. The structure model is the macro model which shows the interrelation between each factor in the system. Based on the fact of this problem, the main influencing factors can be found out by the adoption of ISM.

The nine influencing factors the problem involved include: (1) The stability of the strategic partners in the construction supply chain, (2) The extent of cooperation awareness of the strategic partners, (3) The coordination of the strategic partners, (4) The natural environment (5) Design changes, (6) Inaccuracy of the materials survey, (7) The supply of materials and equipment, as

well as the coordination of the relevant party, (8) The conditions in the construction sites, (9) The handover of each professional process.

Estimate the binary relation and establish reachable matrix: In order to analyze the structural relation of the 9 influencing factors above and have some understanding of the relations between them, it is required to make taut analysis of the binary relation between each index and give a reachable matrix (Tan and Liu, 2008).

For the convenience of the research, this research marks the 9 influencing factors of the project schedule respectively in the construction supply chain. It marks the factor of 'the stability of the strategic partners in the construction supply chain' as M1, the factor of 'the extent of cooperation awareness of the strategic partners' as M2 and so on. For the requirements of this research, it marks 'the project schedule in the construction supply chain' as M10.

In the following part, this research will make analysis aiming on the binary relation between each factor.

As to the factor M1 'the stability of the strategic partners in the construction supply chain', it will exert influence on 'the project schedule in the construction supply chain', 'the extent of cooperation awareness of the strategic partners', 'the coordination of the strategic partners' and 'the supply of materials and equipment, as well as the coordination of the relevant party'.

As to factor M2 'the extent of cooperation awareness of the strategic partners', it will only exert influence on 'the project schedule in the construction supply chain'.

As to factor M3 'the coordination of the strategic partners', it will exert influence on 'the project schedule in the construction supply chain', 'the stability of the strategic partners in the construction supply chain', 'the extent of cooperation awareness of the strategic partners (information sharing)', 'design changes', 'inaccuracy of the materials survey', 'the supply of materials and equipment, as well as the coordination of the relevant party' and 'the handover of each professional process'.

As to factor M4 'natural environment', it will exert influence on 'the project schedule in the construction supply chain', 'design changes', 'inaccuracy of the materials survey' and 'conditions in construction site'.

As to factor M5 'design changes', it will exert influence on 'the project schedule in the construction supply chain', 'the supply of materials and equipment, as well as the coordination of the relevant party' and 'the handover of each professional process'.

As to factor M6 'inaccuracy of the materials survey', it will exert influence on 'the project schedule in the construction supply chain', 'design changes', 'the supply of materials and equipment, as well as the coordination of the relevant party' and 'the handover of each professional process'.

As to factor M7 'the supply of materials and equipment, as well as the coordination of the relevant party', it will exert influence on 'the project schedule in the construction supply chain', 'the stability of the strategic partners in the construction supply chain' and 'the handover of each professional process'.

As to factor M8 'conditions in construction site', it will exert influence on 'the project schedule in the construction supply chain' and 'the handover of each professional process'.

As to factor M9 'the handover of each professional process', it will only exert influence on 'the project schedule in the construction supply chain'.

Based on the analysis above, the reachable matrix R can be established as follows:

$$R' = \begin{array}{c|cccccccccc} & M10 & M2 & M9 & M8 & M5 & M7 & M1 & M4 & M6 & M3 \\ M10 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ M2 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ M9 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ M8 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ M5 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ M7 & 1 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ M1 & 1 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 1 \\ M4 & 1 & 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 & 0 \\ M6 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ M3 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 1 & 1 \end{array}$$

Establishment of explanatory structure model: In the reachable matrix R, no two arbitrary factors have the exactly same factors in both line and row. Therefore, the reachable matrix R cannot be reduced.

In the following part, aiming at the reachable factor R, sequence the factors successively from small to large and make layering dispose according to the number of each row with the factor of 1. Resolve the unit matrix of the maximum order one time from left up corner to right down corner and make additional note of pane with each symbolizing a layer.

Meanwhile, the reachable matrix R is concluded after the sequencing, as seen in the follows:

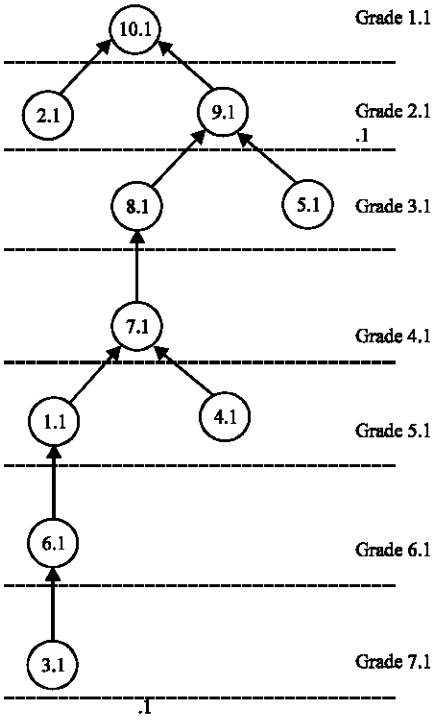

Fig. 1: Structural model of the factors influencing the project schedule in the construction supply chain

$$R = \begin{bmatrix} & M1 & M2 & M3 & M4 & M5 & M6 & M7 & M8 & M9 & M10 \\ M1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ M2 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ M3 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 1 & 1 \\ M4 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 1 \\ M5 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 1 \\ M6 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 1 & 1 \\ M7 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 \\ M8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\ M9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ M10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

After the sequencing reachable matrix R, the system structural model can be established, as seen in Fig. 1.

In the following part, specific factors are written according to the structural model of each factor in the construction supply chain and the explanatory model can be achieved as seen in Fig. 2.

From the analysis above, it can be seen that the factors influencing the project schedule in the model of construction supply chain are various. However, after the analysis, it can be seen that these factors can be generalized into two aspects finally, that is, the extent of cooperation awareness of strategic partners and the handover of each professional process. Therefore, when carrying out the management of the project schedule in the construction supply chain, we can start from these two aspects, take relative measures and guarantee the schedule of the project construction.

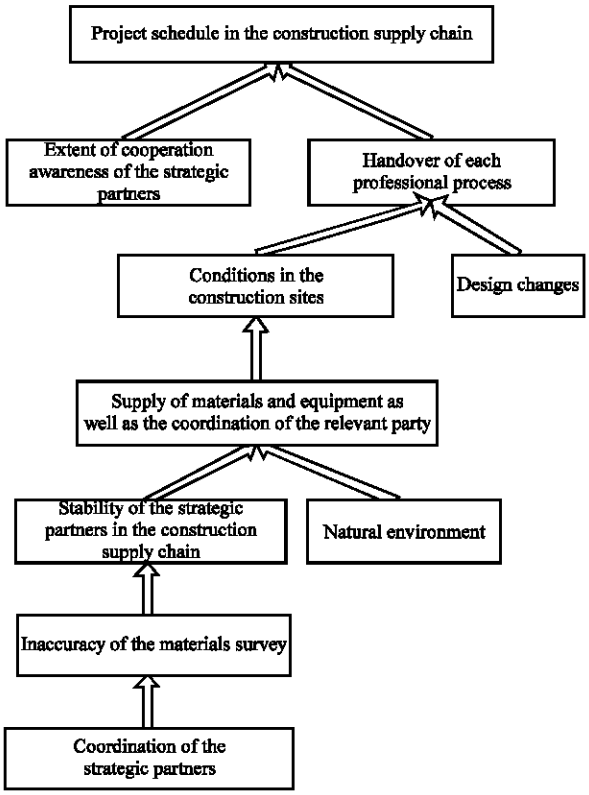

Fig. 2: Explanation model of each factor influencing the project schedule in the construction supply chain

CONCLUSION

In the model of construction supply chain, the factors influencing the project are various. In order to improve the efficiency of management in the construction project schedule, it is necessary to make an analysis of its influencing factors and find the key factor so that the management can be carried out with priority. Based on the ISM method, this paper generalizes the factors influencing the project schedule in the construction supply chain into two aspects, which are the extent of cooperation awareness of strategic partners and the handover of each professional process.

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REFERENCES

De Leeuw, A.C.J. and H.W. Volberda, 1996. On the concept of flexibility: A dual control perspective. Omega, 24: 121-139.

Duclos, L.K., R.J. Vokurka and R.R. Lummus, 2003. A conceptual model of supply chain flexibility. Ind. Manage. Data Syst., 103: 446-456.

Love, P.E.D., Z. Irani and D.J. Edwards, 2004. A seamless supply chain management model for construction. Supply Chain Manage.: Int. J., 9: 43-56.

Milner, J.M. and P. Kouvelis, 2005. Order quantity and timing flexibility in supply chains: The role of Demand characteristics. Manage. Sci., 51: 970-985.

Tan, F. and B. Liu, 2008. Studies on integration and integrating mechanism of owner's organizing interface for large-scale construction projects. Construction Economy, 24: 70-74.

Voudouris, V.T. and A. Consulting, 1996. Mathematical programming techniques to debottlencek the supply chain of fine chemical industries. Comput. Chem. Eng., 20: S1269-S1274.

Yeo, K.T. and J.H. Ning, 2002. Integrating supply chain and critical concepts in engineer-procure-construct (EPC) projects. Int. J. Project Manage., 20: 253-262.