

# Research on the Mechanism of Cross Organizational Knowledge Sharing in BIM Competitive Environment

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**Abstract.** Co-opetition under the environment of BIM implementation process because the level is not high resulting in the project BIM application value of incomplete knowledge sharing among organizations, thus establishing good knowledge can effectively solve this problem and achieve the overall benefit and benefit sharing mechanism in the project organization. This paper defines five competing modes according to the competing degree of organization between different BIM applications, including imperfect competition, competition, competition and cooperation, full cooperation and cooperation, and put forward the conceptual model and related assumptions. Analysis of the effect of path and effect of project determined in BIM application mode, the concurrence of knowledge sharing, efficiency and overall efficiency of the project within the organization through the survey and empirical results, and according to the proposed contract, the distribution of benefits and work three kinds of knowledge sharing mechanism implementation path.

## 1 Introduction

The application of BIM in construction projects is deepening day by day. However, due to the multidisciplinary integration of BIM technology, the application value of BIM needs to be realized by multi-party cooperation. Therefore, BIM application process inevitably occurs. Inter - organizational knowledge sharing.

Claudin [1] proposed four configuration mechanisms for knowledge sharing among organizations. Song Chao [2] His research on the influencing factors of knowledge sharing and knowledge protection among organizations and systematically proposed knowledge sharing and protection strategies and mechanisms. Soekijad and Andriessen [3] put forward the requirement of benign knowledge sharing in competitive alliances. Liao Nuo [4] model of the relationship between the theory of competition and cooperation, knowledge sharing and innovation performance. Shen Nan [5] on the impact of different competitive cooperation environment in the inter-organizational knowledge sharing game and knowledge sharing unit cost relationship. Yang Wei [6] based on the perspective of competition and cooperation, proposed the existence of cooperation and competition is an important mechanism to solve the problem of border dilemma. Yuan Li [7] obtained the knowledge acquisition and interaction of the competing type to the participant by studying the factors that influence the knowledge acquisition in the competitive environment, thus highlighting the importance of competition and cooperation to the knowledge management. These scholars have put forward their own viewpoints and innovative achievements on knowledge sharing in different environments, but they have not studied the application of BIM technology to the cross-organizational knowledge sharing mechanism in competing environment.

Based on the analysis of BIM technology application points according to the interest-related attributes, five competing modes are defined according to the degree of competition and cooperation among BIM application implementation organizations and the knowledge sharing, Organizational benefit and overall benefit of the project, and constructs a theoretical model of BIM application of inter-organizational competition-cooperation model, knowledge sharing and knowledge sharing efficiency, and uses empirical questionnaires and SEM structural equation model to do empirical research, To develop an inter-organizational knowledge sharing mechanism for BIM projects.

## 2 Research hypothesis

BIM technology throughout the project, as a fusion of collaborative tools much professional knowledge, the need to participate in the organization from different angles and professional direction, collaboration and management across organizations in different depth, in order to better realize the goal of the BIM project application [8]-[10]. BIM technology is a comprehensive application of multi-disciplinary expertise, technical software and professional

experience, so this paper uses the way of BIM application to express the knowledge transfer process among organizations.

The BIM implementation process of the project needs to be coordinated by the multi-party organizations. The nature of the organization determines the direction of BIM implementation and the difference of the benefits distribution after BIM implementation, which forms the BIM application environment [11]. According to the competing theory proposed by Brandburger and Nalebuff, the competition and cooperation relations among enterprises are divided into three types: low cooperation low competition, high cooperation high competition, low cooperation high competition and high competition from the relative strength of competition and cooperation. Cooperation and low competition "[12,13]. Based on Luo's four types of competing relations, Wang Liang divided the competing relations into five types: partnership, cooperation, moderation, struggle and isolation [14,15]. In this paper, five competing modes are defined according to the degree of inter-organization competition in the implementation of BIM, including imperfect competition, competition, cooperation, incomplete cooperation and cooperation. Therefore, according to the application of BIM to realize the path (Figure 1), the BIM application based on five kinds of model were classified and made the impact of knowledge sharing across organizations in different degrees of competing project in the hypothesis.

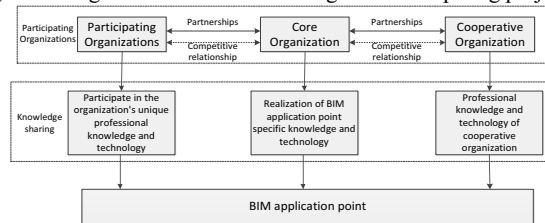


Fig. 1. BIM application point to achieve the path.

## 2.1 Competitive mode

Competition refers to the competition and cooperation mode exists only competition between organizations, the main features of the application for organizing special core competence, the realization of the BIM application process and no other organizations in the implementation of the results has a positive impact on the maximization of the interests of the organization, the organization that cooperate with other organizations to complete this application implementation there is a risk of knowledge, leakage, so the organization competition environment is difficult to carry out knowledge sharing [16]. Accordingly, this paper proposes the following assumptions:

H1 (-). Competitive model has negative impact on cross-organizational knowledge sharing in engineering projects with BIM technology.

## 2.2 Imperfect competition model

Refers to the presence of imperfect competition between organizations in competition based, a kind of competition cooperation model as its main feature, the application for the organization strong core competence, but the need for external organizations to cooperate to complete and achieve multi benefit amount. When the unique professional knowledge of a BIM application belong to the group, after completion of the BIM application, to participate in Inter Organizational cooperation and organization will be less, because the protection of its own core knowledge and influence the level of knowledge sharing [17]. Accordingly, this paper proposes the following assumptions:

H2 (-). The imperfect competition model has a negative impact on cross-organizational knowledge sharing in engineering projects with BIM technology

## 2.3 Co-opetition model

Co-opetition between the organization and the organization refers to both the existence of competition is a mode of cooperation, the specific performance of the application is two or more than two organizations have, and each organization believes that through cooperation with other organizations to enable the application to obtain the maximum lifting at minimum cost. Competition and cooperation mode due to the organization to obtain benefits through cooperation, but with the passage of time, competition and cooperation will occur because of the competition level, the existence of such behavior increases with time and the influence of knowledge sharing [18]. Accordingly, this paper proposes the following assumptions:

H3 (+). Competitive cooperation model has a positive impact on cross-organizational knowledge sharing in engineering projects with BIM technology

## 2.4 Incomplete cooperation model

Incomplete cooperation refers to the existence of cooperation between the organization and the organization, supplemented by a competitive mode of cooperation, the main features of the organization to participate in the hope that through cooperation to enhance their ability to enhance their own. Under the imperfect cooperation mode, the tendency of cooperation is greater than the competition will promote the knowledge sharing between organizations. Accordingly, this paper proposes the following assumptions:

H4(+). Incomplete cooperation model has a positive impact on cross-organizational knowledge sharing in engineering projects with BIM technology

**2.5 Cooperation model**

Cooperation refers to the application points can only be completed through two or more than two organizations, and achieve the purpose of multi benefit. The application of BIM model to achieve the path of cooperation exists in the organization of two or more than two cooperation organization, this process, by cooperation and cooperation organization A B, cooperative organization and participate in organizing and participating organizations and participating organizations cooperate to complete. Cooperation model, the willingness to participate in the organization of strong, high level of knowledge sharing. Accordingly, this paper proposes the following assumptions:

H5(+). Collaborative models have a positive impact on cross-organizational knowledge sharing in engineering projects with BIM technology

**2.6 Organizational performance, the overall effectiveness of the project**

Different competing models can bring about different knowledge sharing benefits, while knowledge sharing benefit is divided into organization benefit and project overall benefit in the Inter Organizational cooperation. It is precisely because of the existence of this kind of knowledge sharing performance, which will affect the behavior of each organization in the knowledge sharing, so it will be the factors that affect the overall efficiency of the organization and the overall benefit of the project. Accordingly, this paper proposes the following assumptions:

H6(+). Knowledge sharing has a positive effect on the intra-organizational benefits of engineering projects with BIM technology.

H7(+). Knowledge sharing has a positive impact on the overall benefit of the engineering project in the application of BIM technology.

H8(+). There is a positive correlation between the overall benefit of the project and the benefit within the organization.

Based on the above assumptions, the theoretical model of the relationship between the organization of BIM application and the benefit of knowledge sharing and knowledge sharing is constructed (Figure 2).

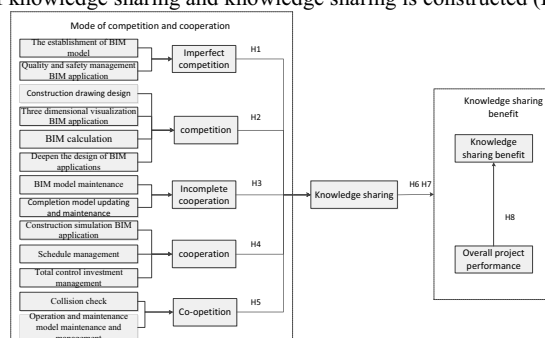


Fig. 2. BIM application of inter-organizational cooperation model, knowledge sharing and knowledge sharing effectiveness of the theoretical model.

**3 Rmpirical research**

**3.1 Questionnaire**

This research mainly with reference to domestic and foreign mature measurement table has the relevant variables, sharing and knowledge sharing within the organization efficiency, the preliminary design of the project overall benefit from the five competing measure of knowledge, the organization mainly discusses the application of BIM technology in the project of different degree of competition and cooperation of knowledge sharing and knowledge sharing benefits the impact and the corresponding mechanism, the questionnaire for the object with the organization nature, organization scale, BIM application ability as control variables in the study of influence factors. Survey questionnaire using the form of Likert five component to measure variables, variable range from 1 to 5 points, 1 of the total does not meet, 5 said in

full compliance, followed by. The questionnaire issued a total of 300 questionnaires, 198 valid questionnaires were recovered, the recovery rate was 66%.

**3.2 Reliability and validity test**

In this paper, SPSS 22.0 software for questionnaire survey data reliability and validity of the empirical analysis of variables for the reliability and validity test. The calculation of all the factors of Cronbach 'alpha value between 0.7 to 0.9, which indicates that the scale has high reliability, good internal consistency and validity; found from the test results, all factor KMO values are greater than 0.6, and each item of the load factor is greater than 0.6 and less than 0.8, which indicates that the scale has good structural validity, optimal model with a good degree.

**4 Empirical result analysis**

**4.1 Theoretical model checking**

In this paper, we use the SEM21.0 structural equation model to estimate the path coefficient and its fitting index, and the test parameters are  $\chi^2 = 23.835$ ,  $df = 12$ ,  $\chi^2/df = 1.743$ , between the ideal reference value 1~3, the model matches well;  $CFI = 0.986$ ,  $IFI = 0.972$ ,  $TLI = 0.934$ , both were larger than 0.9, which showed good fit for the model;  $RMSEA = 0.066 < 0.08$ , all indexes reach the acceptable range, which indicates that the theoretical model constructed in this paper is reasonable.

**4.2 Hypothesis test**

The standard path coefficient model is obtained by the method of structural equation model (Figure 3), of which 1) competition on knowledge sharing effect standard coefficient is - 0.23,  $P < 0.01$ , assuming H1 support;2)imperfect competition on knowledge sharing effect of standard coefficient is -0.19,  $P < 0.01$ , H2 supported hypothesis 3); the competition and cooperation of knowledge sharing standard coefficient of 0.09,  $P < 0.01$ , assuming H3 is supported; 4) do not fully cooperate on knowledge sharing standard coefficient of 0.19,  $P < 0.01$ , assuming H4 is supported; 5) cooperation on knowledge sharing standard coefficient of 0.26,  $P < 0.01$ , H5 hypothesis is supported; 6) knowledge sharing within the organization efficiency standard coefficient is 0.09 ,  $P < 0.01$ , assuming H6 is supported; 7) knowledge sharing standard coefficient on the overall efficiency of the project is 0.39,  $P < 0.01$ , H7 hypothesis is supported; 8) project The overall effectiveness of the standard coefficient of efficiency within the organization is 0.35,  $P < 0.01$ , assuming that H8 is supported. As a whole, the degree of competition and cooperation directly affects knowledge sharing, which indirectly affects the efficiency of the organization and the overall benefits of the project.

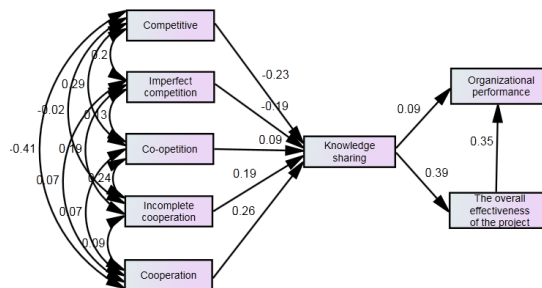


Fig. 3. Standard parameter estimation model.

**5 Knowledge sharing mechanism**

The organization according to the results of the study and application of BIM technology combined with the project of cooperation and competition of the actual situation, put forward the contract mechanism, interest distribution

mechanism and knotworking cooperation mechanism of three kinds of cross organizational knowledge. The empirical results suggest that the greater the degree of competition in the knowledge sharing level is low, the greater the degree of cooperation of knowledge sharing the higher the level of knowledge sharing level directly affect the overall benefit and project organization, this paper puts forward the knowledge sharing mechanism to improve the organization and participation degree, knowledge sharing motivation and determine the application of BIM model set up (Figure 4). BIM competing environment of inter organization knowledge sharing mechanism path is as follows: firstly, according to the different competing model for contract mechanism, competition mode, imperfect competition mode and competition mode of cooperation, focusing on formulating the participation constraint scope of the organization work related to the terms of the contract, increase participation organization cooperation degree; according to incomplete cooperation mode, cooperation mode, focus on make the protection involved in the organization of professional knowledge related terms, due to the degree of cooperation too closely to lead to knowledge leaks; in the premise of good knowledge sharing environment, establish a reasonable profit distribution mechanism, in order to improve the knowledge sharing motivation; finally, according to the work mechanism, breaking the boundaries of knowledge of BIM application, to achieve the overall benefits of project.

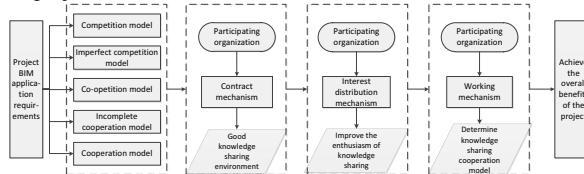


Fig. 4. the role of cross organizational knowledge sharing mechanism in BIM competitive environment.

## 6 Conclusion

By constructing the structural equation model, this paper studies the influence of the relationship between the organization of the engineering project and the application of BIM technology on the knowledge sharing and the benefit of knowledge sharing, according to the empirical results of the organization with the application of BIM technology in engineering project of the competition and cooperation of the actual situation, put forward the contract mechanism, interest distribution mechanism and node (knotworking) mechanism of three kinds of knowledge sharing mechanisms. 1) the contract mechanism, in the organization of knowledge sharing, should be in advance of the norms of the organization and the scope of responsibility and knowledge sharing, create a good knowledge sharing environment, in order to improve the enthusiasm of participating in organizational knowledge sharing; 2) the interest distribution mechanism, set up a good benefit distribution system, in order to encourage the participation of the organization of knowledge sharing, manufacturing knowledge sharing virtuous circle; 3) knotworking cooperation mechanism, can quickly break the boundaries of knowledge, improve the efficiency of knowledge sharing. The contract mechanism establishes a good knowledge sharing environment, the interest distribution mechanism improves the participation of the organization knowledge sharing initiative, the working mechanism provides a knowledge sharing mode of work.

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