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Barriers and Coping Strategies of Information Technology Implementation in Chinese Construction Enterprises

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Abstract: Information Technology (IT) plays a key role for the development of Chinese construction enterprises, which has important strategic significance. But in the actual application process, it has encountered some difficulties and obstacles in the Chinese construction enterprises. A questionnaire-based research approach, at the three levels of industry, enterprise and project, was adopted to analyze the factors that affect the selection and use of project management software, the benefits IT can take to the enterprises, the barriers of IT implementation and its coping strategies.

Key words: Barriers, coping strategies, information technology

INTRODUCTION

The importance of Information Technology (IT) strategic location has become increasingly prominent. But IT is still on the surface in construction industry (Wu and Peng, 2004). Effective proved project management can increase the project performance by 30% and even more (Yu and Zhu, 2008). Its affects the construction business in production process by strategic decision making at all levels (Dai, 2006). How to use information technology to transform and upgrade the level of project management is the objective requirement of future development (Yang, 2006).

OBSTACLE FACTORS AND COPING STRATEGIES

Obstacle factor: The Information Technology (IT) applications in the construction industry have been lagged behind other industries. History, industry and market factors are reformed the industry's structure and culture and it influences IT application in probability, depth and maturity for important business (Stewart *et al.*, 2004). Summing up relevant literature, we list each obstacle factors of project management software applications at three levels: Industry level, enterprise level and project level, as Fig. 1.

Coping strategies: The importance of coping strategies is to overcome and adjust from the three levels of industries, enterprises and projects, based on the determination of

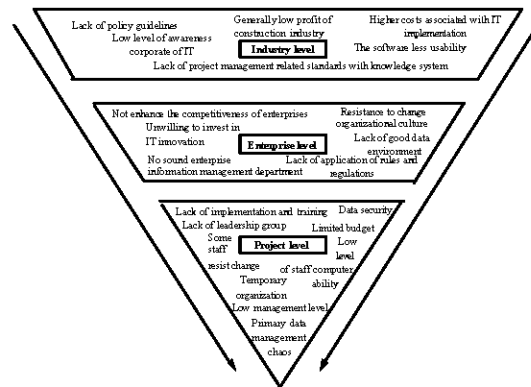


Fig. 1: Layered barriers of IT applications

these impediments. From the comprehensive basis of existing literature, we find a set of coping strategies of these impeding factors in Fig. 2.

SURVEY AND ANALYSIS

Questionnaire design: Questionnaire design centers around the IT application obstacles and coping strategies in construction business. Besides the basic information of the respondents, the questionnaire also set up the other nine questions, which were about integration of the influence of advanced IT technology on project management, the most important drivers and most concerned factors of the enterprise in the selection of project management software, as well as the listed

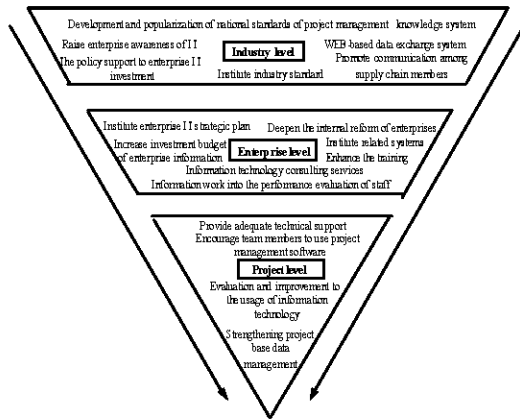


Fig. 2: Coping strategies of IT application

Table 1: Influence of IT to project management

Code	Impact statement	Importance	No.
K	Multiple projects management simultaneously	4.9	1
A	Improve the efficiency of the project schedule	4.41	2
F	Improve efficiency	4.14	3
J	Improve control of project progress	4.14	4
E	Reduce the decision time	3.65	5
I	More efficient allocation of resources	3.62	6
H	Risk warning as soon as possible	3.54	7
L	Improve the monitoring of perform	3.46	8
B	Improve cost control in operations	3.43	9
D	Improve the quality of decision	3.43	10
G	Shorten the duration of the project	3.43	11
C	Better quality control of projects	3.24	12
M	Better HSE management	2.89	13

Table 2: Key drivers of enterprise choosing IT

Code	Drivers explain	Importance	No.
A	Owner or investor requirements on project management software	3.81	1
B	Improve the level of project management	3.81	2
C	Improve project performance	3.59	3

obstacles in IT application to judge the importance of coping strategies at industry, enterprise and project aspects. The respondents were asked to rate the factors listed, score interval [1, 5], "1" totally disagree, "5" in full agreement.

Key drivers of IT applications: The impact of IT works on project management is shown in Table 1.

Through investigation, the greatest impact of project management software is the ability to make multiple project management simultaneous. What's more, the project plan can improve the efficiency of the project schedule. Schedule of management is a special indispensable part of the basis in all management (Li and Zhang, 2007). Successful implementation of IT can provide a multiplier effect, so we need to look at the key drivers of construction company in the selection of project management software in Table 2.

Table 3: Importance evaluation of main factors impeding on industry level

Code	Drivers explain	Importance	No.
E	Lack of project management related standards with knowledge system	3.92	1
D	Low level of corporate awareness	3.76	2
F	The software less usability	3.46	3
C	Higher costs	3.43	4
B	Generally low profit of construction industry	3.38	5
A	Lack of policy guidelines	3.22	6

Table 4: Importance evaluation of main factors impeding on enterprise level

Code	Drivers explain	Importance	No.
E	No sound enterprise information manage department	3.65	1
C	Without seeing potential benefits	3.62	2
G	Lack of good data environment	3.57	3
F	Lack of application of rules	3.54	4
D	Resistance to change organizational culture	3.49	5
A	Unwilling to invest in IT innovation	3.38	6
B	Not enhance the competitiveness	2.7	7

Table 5: Average of main factors impeding the IT application on project level

Code	Drivers explain	Importance	No.
D	Lack of leadership group	3.81	1
I	Primary data management chaos	3.7	2
H	Low management level	3.51	3
E	Some staff of low computer level	3.46	4
F	Temporary organization	3.46	5
C	Limited budget	3.41	6
A	Tight project schedule, Lack of implementation and training	3.11	7
G	Some staff resist change	2.86	8
B	Data security	2.73	9

As described in Table 2, the demand of owners or investors on project management software and the improvement of project management become the key drivers in the selection of project management software.

Main obstacles in IT application: From the industry point, the main factors impeding IT application are shown in Table 3. The importance evaluation in Table 3 shows that lack of relevant standards of project management knowledge is the main impediment (3.92) in IT application at the industry level. Besides, enterprise IT awareness is low (3.76).

At the enterprise level, the main factors impeding the IT application are shown in Table 4. From Table 4, we can see that there is no sound enterprise information management (3.65) as the main impediments of IT application at the enterprise level. Business leaders could not see the potential benefits of project management software (3.62), which is the second factor.

At the project level, the main factors impeding IT application are shown in Table 5. The importance evaluation in Table 5 shows that lack of leading group of project management software (3.81) is the main impediment in IT application at the project level. Besides, with primary data management chaos (3.7), project

Table 6: Relativity of barriers and coping strategies: Industry level

Code	Coping strategies	Feasibility evaluation	Coding and correlation coefficient	Importance	No.
CS1	Policy support to enterprise IT investment	3.46	A (0.11)	11.14	8
			B (0.22)	11.69	6
			C (0.41)	11.87	4
CS2	Flexible definition of standard management processes and information format by IT, promote communication among supply chain members	3.43	A (0.10)	11.04	7
			F (0.04)	11.87	5
CS3	Raise enterprise awareness of IT	3.43	D (0.16)	12.9	1
CS4	WEB-based data exchange system	3.27	F (0.18)	11.31	7
CS5	Development and popularization of national standards of project management knowledge system	3.19	E (0.47)	12.5	2
CS6	Institute industry standard	3.14	E (0.25)	12.31	3

Table 7: Relativity of barriers and coping strategies: Enterprise level

Code	Coping strategies	Feasibility evaluation	Coding and correlation coefficient	Importance	No.
CS1	Deeping the internal reform, carding process, integration project management software	3.68	D(0.39)	12.84	4
			E (0.51)	13.43	1
CS2	enhance information and project management knowledge training of all staff	3.62	C (0.23)	13.1	2
			D (0.33)	12.63	5
			G (0.45)	12.92	3
CS3	Increase investment budget of enterprise information	3.46	A (0.38)	11.69	13
CS4	Institute related systems, implement the software implementation	3.43	F (0.33)	12.14	8
CS5	Information work into the performance evaluation of staff	3.43	D (0.30)	11.97	12
			G (0.36)	12.25	6
CS6	recurring to information consulting services, shorten the time to import software	3.43	A (0.31)	11.59	14
			F (0.39)	12.14	9
			G (0.41)	12.25	7
CS7	Institute enterprise IT strategic plan	3.32	A (0.20)	11.22	15
			C (0.05)	12.02	11
			E (0.13)	12.12	10

manager cannot provide timely and accurate data to meet the demand of project management software to improve the accuracy and level.

Coping strategies and barriers: As described above, we obtain the main hindering factors of IT application in the Chinese construction enterprises by questionnaire. Then we associate barriers in Fig. 1 with coping strategies in Fig. 2. Respondents were asked to make a feasibility assessment of strategies for the impediments. Score interval is [1, 5], "1" means total disagree and "5" means full agree. On the basis of the importance evaluation of barriers (Table 3) and feasibility evaluation of coping strategies (Table 6), we return the correlation coefficient of two values through CORREL (Array 1, Array 2). Finally, we calculate the importance of barriers and coping strategies, as in Eq. 1.

$$\text{Importance evaluation of barriers} \times \text{Strategies feasibility evaluation} = \text{Importance} \quad (1)$$

In the process of calculating the importance of these impeding factors and coping strategies, we develop the following principles:

- Remove the barriers, its importance evaluation are less than 3
- Remove obstacles and strategies, its correlation factors and the feasibility evaluation of coping strategies are less than 0
- Remove the barriers and coping strategies, its importance is less than 10

First, we do correlation analysis of coping strategies and barrier factors at industry level. There are altogether 7 associated factors through the above principles at this level, as in Table 6. According to the analysis, the most important correlation coefficients are CS3-D (12.90) and CS5-E (12.50).

Second, we do correlation analysis of coping strategies and barriers at enterprise level. Because of the importance evaluation (2.7) of impediments, "not enhance the competitiveness" (code B) is less than 3, so it cannot associate with coping strategies. According to the analysis, correlation coefficient CS1-E (13.43) and CS2-C (13.10) become the most meaningful, as in Table 7.

Finally, we do the correlation analysis of coping strategies and barriers at project level. Due to the importance evaluation (2.86) of impediments, "some staff

Table 8: Relativity of barriers and coping strategies: project level

Code	Coping strategies	Feasibility evaluation	Coding and correlation coefficient	Importance	No.
CS1	Provide adequate technical support(such as training)	4.03	A (0.21)	12.53	15
			D (0.17)	15.35	1
			E (0.22)	13.94	9
			F (0.05)	13.94	10
			H (0.01)	14.15	8
			I (0.21)	14.91	2
CS2	Encourage team members to use project management software	3.89	A (0.01)	12.1	16
			D (0.17)	14.82	3
			E (0.08)	13.46	13
			I (0.19)	14.21	5
CS3	Strengthening project base data management	3.84	D (0.02)	14.63	4
			H (0.07)	13.48	12
			I (0.27)	14.21	6
			I (0.11)	14.21	7
CS4	Evaluation and improvement to the usage of information technology	3.73	H (0.25)	13.09	14
			I (0.08)	13.8	11

Table 9: Barriers and coping strategies: industry level

Code	Barriers	Coping strategies
D	Low level of corporate awareness of IT	1.Raise enterprise awareness of IT
E	Lack of project management related standards with knowledge system	1.Development and popularization of national standards of project management knowledge system 2.Institute industry standard
F	Software less usability	1.Flexible definition of standard management processes and information format by IT, promote communication among supply chain 2.WEB-based data exchange system
A	Lack of policy guidelines	1. Policy support to enterprise IT investment 2.Flexible definition of standard management processes and information format by IT, promote communication among supply chain

resist change "(code G) and "data security" (code B) are less than 3, so they cannot participate in the association with of coping strategies. Except correlation coefficient CS2-H (-0.06) and CS3-A (-0.04) less than 0, there are altogether 16 associations, as in Table 8. Through analysis of the survey results, we find the first two most important associations are the CS1-D (15.35) and CS1-I (14.91).

ADVICE

From the above analysis of the questionnaire results, we summarize the following recommendations. In Table 9, 10 and 11, the main barriers and the most appropriate response strategies are particularly listed to overcome these barriers of IT applications at industry, enterprises and projects level. The code taxis in table is by the importance of barriers and coping strategies, decreasing in turn. In order to ensure that such coping strategies identified by experience are fully consistent with construction industry stakeholders, it is necessary to give the following practical suggestions:

- In the IT project life cycle, it is necessary to establish and consolidate a high-level management organization

- Enterprise makes an appropriate budget to determine the long-term continual application of IT
- Enterprise makes Plans for the IT-related changes caused by the conduct going progressive

CONCLUSION

First, the key drivers of enterprises in selection of the project management software are:

- Requirements of the owner or investor for project management software (A, 3.81)
- Improvement of the project management (B, 3.81)

Second, at all the three levels, the most important barriers and most practical coping strategies filtered out are listed as:

- **Industry level:** CS3-D, Low level of corporate awareness of IT (code D)-Raise enterprise awareness of IT (code CS3)
- **Enterprise level:** CS1-E, No sound enterprise information manage department (code E)-Deeping the internal reform, carding process and integration project management software (code CS1)

Table 10: Barriers and coping strategies: enterprise level

Code	Barriers	Coping strategies
E	No sound enterprise information manage department	1. Deeping the internal reform , carding process, integration project management software 2. Institute enterprise IT strategic plan
C	Without seeing the potential benefits	1. Enhance information and project management knowledge training of all staff 2. Institute enterprise IT strategic plan
G	Lack of good data environment	1. Enhance information and project management knowledge training of all staff 2. Information work into the performance evaluation of staff 3. Enhance information and project management knowledge training of all staff
F	Lack of application of rules and regulations	1. Institute related systems, implement the software implementation 2. Recuring to information consulting services, shorten the time to import software
D	Resistance to change organizational culture	1. Deeping the internal reform , carding process, integration project management software 2. Enhance information and project management knowledge training of all staff 3. Information work into the performance evaluation of staff
A	Unwilling to invest in IT iunovation	1. Increase investment budget of enterprise information 2. Recuring to information consulting services, shorten the time to import software 3. Institute enterprise IT strategic plan

Table 11: Barriers and coping strategies: project level

Code	Barriers	Coping strategies
D	Lack of leadership group	1. Provide adequate technical support(such as training) 2. Encourage team members to use project management software 3. Strengthening project base data management 4. Evaluation and improvement to the usage of information technology
I	Primary data management chaos	1. Provide adequate technical support(such as training) 2. Encourage team members to use project management software 3. Strengthening project base data management 4. Evaluation and improvement to the usage of information technology
H	Low management level	1. Provide adequate technical support(such as training) 2. Encourage team members to use project management software 3. Evaluation and improvement to the usage of information technology
E	Some staff of low computer level	1. Provide adequate technical support(such as training) 2. Encourage team members to use project management software
F	Temporary organization	1. Provide adequate technical support(such as training)
A	Tight project schedule, lack of implementation and training	1. Provide adequate technical support(such as training) 2. Encourage team members to use project management software

- **Project level:** CS1-D, Lack of leadership group (code D)-Provide adequate technical support (such as training) (code CS1)

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