BARRIER OF TECHNOLOGY TRANSFER FOR CONSTRUCTION PROJECTS: A COMPARATIVE STUDY BETWEEN IRAN AND MALAYSIA

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ABSTRACT

Technology transfer in the international construction industry is an important source as it helps companies move to better stages of design and construction capabilities. Three main barriers of technology transfer in construction have been identified through literature review - language barrier, cultural barrier and procurement options. The importance of these barriers has been verified through surveys in the construction industry in Iran and Malaysia. Totally 102 responses were received. Most of construction professionals in Iran and Malaysia consider technology transfer as an important issue in construction. Through SPSS application, the impacts of these barriers have been analysed. The impact percentages are; language barrier: 12.1%, cultural barrier: 52.8% and procurement options 88.3%. In comparison between Iranian construction professionals and Malaysia professionals, Malaysians showed less impact in language and culture barrier but higher impact in procurement options than Iranians. Future researches are required in procurement options particularly in Iran.

Keywords: Technology Transfer; Construction; Barrier

INTRODUCTION

Technology transfer is an important element of relationship among construction companies, especially in the international construction industry. Further, transfer of technology in

construction is a source of creativity that makes the company designs and constructs with new technologies. Then the companies are expected to transform and improve the current stage of technologies to the better stages. The process of technology transfer is based on the value and protection of products. It also includes several specific physical processes, systematic methods and managerial arrangements for functioning of the transformation [1, 2]. However, there are several obstacles to transfer of technology.

This research verifies the importance of technology transfer in international construction and investigates the impact of three main barrier of technology transfer in the Malaysia construction industry and the Iranian construction industry. The three main barrier identified through literature review are: language barrier, cultural barrier and procurement options. The objectives of this research are to identify the following relationships in Iran and Malaysia and make comparison between these two construction industries.

- Relationship between language barrier and technology transfer in construction projects.
- Relationship between cultural barrier and technology transfer in construction projects.
- Relationship between procurement options and technology transfer in construction projects.
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LITERATURE REVIEW

Kumaraswamy and Shrestha [3] explain that the two enablers are associated to technology transfer – transferor (foreigner) and transferee (host). The transferor's elements comprise four sub-factors, (a) willingness to transfer technology, (b) level of experience, (c) cultural traits and (d) knowledge base. On the other hand, the elements of transferee are (a) intent to learn technology, (b) level of experience, (c) cultural traits and (d) knowledge base. In construction, many researchers have stated that technology transfer in construction is a broadly important influential source of creativity. This helps construction companies to be equipped with new technologies that can properly transform and enhance present technologies to better stages of performance. Typical technology transfer barrier in construction are [4,5,6]: lack of time, organizational culture, capacities of individual (e.g. training skills), lack of clear policy, national/ethnic culture differences, attitudes of individuals (e.g. reluctance), lack of clear agreements, lack of clear procedures, lack of funding provisions, language and procurement. Through intensive and extensive literature review three main barrier of technology transfer have been identified- language barrier [7, 8], cultural barrier [9, 10] and barrier in relation to procurement[10, 11, 12].

RESEARCH METHODOLOGY

A total of 300 questionnaires were distributed in Iran and Malaysia and 102 replies were received with return rate of 34%- 48 replies from Iran and 54 replied from Malaysia. To increase the response rate, the questionnaires were distributed manually and collected later manually. The participants of the survey include architects, engineering consultants, quantity surveyors, contractors and construction managers. SPSS (Statistical Package for Social Sciences) has been used for the analysis of data.

The survey participants were asked to complete the survey to show their perceptions on language barrier, cultural barrier and procurement options to technology transfer in construction projects. SPSS statistical package 21 has been used for the analysis of data collected in this study. Data collected from the replies to the questionnaire were analysed using descriptive statistics, multiple regression and correlation analysis.

FINDINGS OF THE SURVEY

Reliability test

Reliability tests in the independent variables and dependant variables are conducted. Cronbach's Alpha was calculated. To have the reliable variables, Cronbach's Alpha coefficient needs to reach 0.7 for a reliable internal consistency. As it shown in Table 1, the Cronbach's Alpha value is higher than 0.7, and in case of culture statistics, as the number of items is below six, Cronbach's Alpha value 0.686 is acceptable.

Table 1. Reliability tests

Variables	Cronbach's Alpha	Number of items
Language Statistics	0.720	2
Culture Statistics	0.686	5
Procurement Statistics	0.818	12
Technology Transfer Barrier Statistics	0.773	2

Seriousness of technology transfer in international construction

As can be seen from Table 2, only less than 10% of engineers from Iran and Malaysia consider that technology transfer in international construction is a minor barrier. The others consider it as average barrier (48.9%) and serious barrier (41.5%). There is common denominator for Iranian professionals and Malaysian professionals in respect to the seriousness of technology transfer in the construction industry.

Table 2. Seriousness of technology transfer in international construction

	From experience, technology transfer in international construction are:			
	Minor barrier	Average barrier	Serious barrier	Total
Iranians	6 (14.6%)	19 (46.3%)	16 (39%)	41
Malaysians	3 (5.7%)	27 (50.9%)	23 (43.4%)	53
	9 (9.6%)	46(48.9%)	39 (41.5%)	94

Relationships with technology transfer

The hypotheses have been evaluated from the analysis of the survey outcomes. Iranian and Malaysians have been combined to a single group to identify the overall perceptions of these two nationalities on technology transfer.

Hypothesis 1:

H_{a1}:There is a significant relation between language barrier and technology transfer in construction projects

H_{o1}: There is no significant relation between language barrier and technology transfer in construction projects

After doing a regression test, as it shown in Tables 3 and 4, p-value is under 0.05 and the null hypothesis is rejected and the alternative hypothesis is accepted. The R-square is 0.121 so it has 12.1% impact as a barrier in construction projects in technology transfer.

Hypothesis 2

H_{a2}: There is a significant relation between cultural barrier and technology transfer in construction projects

H_{o2}: There is no significant relation between cultural barrier and technology transfer in construction projects

As can be observed from Tables 5 and 6, the p-value is below 0.05 so the alternative hypothesis is accepted. The impact of cultural barrieras independent variable is 52.8% on technology transfer in construction.

Hypothesis 3

H_{a3}: There is a significant relation between procurement option barrier and technology transfer in construction projects.

H_{o3}: There is no significant relation between procurement option barrier and technology transfer in construction projects.

According to Tables 7 and 8, p-value is below 0.05 so for this hypothesis, the alternative hypothesis is accepted. The R-square for this test is 0.883. So procurement options have the strongest impact on technology transfer barrier with 88.3% impact.

Table 3. Model summary for Hypothesis 1

Model	R	R Square	Adjusted R Square	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
1	.348[a]	.121	.103	.121	6.808	2	99	.002

Table 4. ANOVA[a] for Hypothesis 1

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.491	2	1.745	6.808	.002[b]
Residual	25.382	99	.256		
Total	28.873	101			
a. Dependent Variable: Tech_transfer_barrier					
b. Predictors: (Constant), Foreign supervisor faces language problems, Communication in multi-cultural construction sites is even more complicated					

Table 5. Model summary for Hypothesis 2

Model	R	R Square	Adjusted R Square	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
1	.727[a]	.528	.503	.528	21.473	5	96	.000

Table 6. ANOVA[a] for Hypothesis 2

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	15.243	5	3.049	21.473	.000[b]
Residual	13.630	96	.142		
Total	28.873	101			
a. Dependent Variable: Tech_transfer_barrier					
b. Predictors: (Constant), Lack of continuous, open and honest communication, Unfair					

sharing of risks or rewards among the client and the project participants, Understanding the culture of staff from different countries, Cultural differences for companies operating in international markets is critical, Unsolved arguments

Table 7. Model summary for Hypothesis 3

Model	R	R Square	Adjusted R Square	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
1	.940[a]	.883	.867	.883	54.645	12	87	.000

Table 8. ANOVA[a] for Hypothesis 3

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	25.171	12	2.098	54.645	.000[b]
Residual	3.339	87	.038		
Total	28.510	99			

a .Dependent Variable: Tech_transfer_barrier

b. Predictors: (Constant), High cost of tendering in PPP/PFI projects, Procurement laws and regulations negatively effect in design/build contract, Changes in design during construction, Local partners (companies) have no input on design in design/build contract, Partners failed to build a trust relationship, Unnecessary interference from government for PPP/PFI projects, Partners failed to share information, PPP/PFI contracts create/required complicated negotiations, Long process in design procedure in design-bid-build, Too long concession period for PPP/PFI projects, Partners' lack of win-win attitude, Misunderstanding/conflict due to laws and regulations of local government

Comparison between Iranians and Malaysians

Multi-regression analysis has been conducted to identify the differences among language, cultural and procurement options as barrier against technology transfer and to make a comparison between Iran construction and Malaysia construction. The impacts of these three items are defined in the relation below:

T = a + bX + cY + dZ

T= Technology transfer barrier in construction projects

X = Culture barrier

Y = Language barrier

Z = Procurement options

As can be seen from Table 10 and Table 11the formulae for Iranians and Malaysians are

T = - 0.051+ 0.278 × Culture barrier + 0.106 × Language barrier + 0.644× Procurement options (Iranians)

T = - 0.22+ 0.156 × Culture barrier - 0.1× Language barrier + 1.011× Procurement options (Malaysians)

For both countries, procurement options have the strongest influence on technology transfer barrier in construction projects and the next position is cultural barrier, and language barrier have the weakest impact in comparison to other variables.

Table 9. Iranians' coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.051	.190		-.269	.789
Procurement options	.644	.056	.695	11.603	.000
Culture	.278	.059	.302	4.686	.000
Language	.106	.039	.151	2.722	.009
Dependent Variable: Tech_ transfer_ barrier					

Table 10. Malaysians' coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.220	.255		-.862	.393
Procurement options	1.011	.092	.819	10.983	.000
Culture	.156	.058	.207	2.702	.009
Language	-.100	.042	-.156	-2.402	.020
Dependent Variable: Tech_ transfer_ barrier					

Malaysians show less impact in cultural barrier compared to Iranians. Malaysia is comprised of three major ethnic groups – Malay, Chinese and Indians. This multi-cultural background of the country might the cause of the flexibility in cultural barrier. Similarly Malaysians use English language as their second language and this is reflected in language barrier, showing a negative coefficient. In many construction projects in Malaysia, construction professionals have good commands on English language and quite often construction documents such as Bill of Quantities, Specification and Conditions of Contract are produced in English language. Therefore for Malaysian construction professionals, language skills are not barrier in international projects. In case of Iran, due to lack of tourism and less foreign professionals working in the country, communications with foreign engineers have become an important issue. Further higher educations in Iran are all taught in Persian language. Possibly these are the causes of higher impact of language barrier in Iran.

Malaysians consider the impact of procurement options far higher than Iranians. The Malaysia construction industry has experienced various kinds of procurement options including PPP (Public Private Partnership) and BOT (Build Operate Transfer), etc. [13, 14, 15, and 16]. Further Malaysian construction professionals perceive that procurement options are important factors for the success of construction project and the performance of construction companies in Malaysia [17, 18]. In case of Iran, the construction market is not completely open to foreign investors. In addition, the construction projects in Iran are not attractive for foreign investors, due to high risk factor [19]. Therefore, it seems that the Iran construction industry could not receive the opportunities to practice various project procurement systems, and consequently the construction professionals in Iran do not fully appreciate the importance of procurement options in technology transfer.

CONCLUSION

Through this research the importance of technology transfer in international construction have been verified. The survey showed that both Iranian construction professionals and Malaysian construction professionals consider technology transfer as an important issue in the construction industry - average barrier (48.9%) and serious barrier (41.5%). Further three main barrier of technology transfer have been verified and analysed through the questionnaire survey in the construction industry in both Iran and Malaysia. These are language barrier, cultural barrier and procurement options. Significant relations have been found between 'technology transfer in international construction' and all of these three barrier. The impact percentages are language barrier: 12.1%, cultural barrier: 52.8% and procurement options 88.3%. In most international construction projects, the professional workers have sufficient English skills as international language. Possibly this is the cause of low impact from language barrier. To overcome cultural barrier, diverse cultural programmes need to be considered in international construction environments. Procurement options particularly with respect to PPP/PFI should be studied in depth to implement efficient and effective technology transfer. In comparison between Iranian construction professionals and Malaysia construction professionals, Malaysians show less impact in cultural barrier and language barrier compared to Iranians, mainly because of the multi-cultural background and English language background of the country. However, Malaysians show far higher impact in procurement options. This is due to the knowledge and experience acquired through implementation of various procurement systems in the Malaysia construction industry. Further researches are required to conduct in-depth investigation into the Iran construction industry with respect to

the relationship between procurement options and technology transfer, especially design-build, PPP/PFI type procurement systems. The outcomes of this research will make a good contribution in respect to technology transfer barrier in construction especially for developing countries. For future research, the investigation can be extended to other countries in Asia and/or Africa to understand differences and make comparisons between regions and countries.

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