

Sharing Construction Safety Knowledge through Social Networks

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Abstract

Construction employees' lack of safety knowledge is one of the most important reasons for the high accident rate in the construction industry. Research into safety knowledge sharing through social networks is crucial because social networks are a significant vehicle for the transfer of knowledge. This study discusses what kinds of employees are usually consulted by others separately on safety knowledge, and how safety knowledge is transferred among employees in different positions on construction sites in order to use specific measures to improve construction safety knowledge sharing. This study adopted the name-nominated method to design the questionnaire, and investigated 267 employees on 24 construction sites in the Chinese mainland. The logistic regression and frequency analysis methods were used to analyze how construction employees selected ten types of social relations as the objects of their safety knowledge sharing; these included family, friends, colleagues, former classmates, and so on. The study also discusses the effects of different age, work type, education and tenure on employees' choice of safety knowledge sharing objects. Safety knowledge sharing networks based on job position on the construction site are described, and finally, the study further discusses the above findings from both theory and comparison aspects. The results of this study led us to the conclusion that "masters" and gangmasters should play a more important role in safety knowledge sharing, that less educated and low-tenure employees prefer to put safety-related questions to their supervisors, and that the education factor is more critical than tenure. The study also puts forward some suggestions to improve the safety knowledge sharing of construction employees, including strengthening the safety responsibility and knowledge level of "masters" and gangmasters, and enhancing the provision of supervisors' safety education to novice and less educated employees.

Keywords: construction safety, construction site, gangmaster, master, demographic character

1. Introduction

Construction safety is a major issue worldwide, and the large number of construction-related accidents and unsafe incidents causes considerable damage in many societies every year. Many investigations have shown that employees' lack of safety knowledge is a critical reason for the high accident rate in the construction industry (Huang 2001; Jiang 2002; Chua and Goh 2004; Hadikusumo and Rowlinson 2004). Therefore, improving employees' safety knowledge would be a significant way to enhance construction safety.

Currently, safety training is the main channel to improve construction safety knowledge. However, there are many kinds of tacit knowledge in the construction industry (Fong and Chu 2006). Knowledge can be divided into explicit and tacit knowledge, and tacit knowledge is nonstandard, difficult to express in language, and can only be easily understood through thinking and practice. Current safety training is untimely, passive, limited by the environment and works against the transfer of tacit knowledge (Jiang 2002). A study on safety knowledge sharing in social networks is therefore greatly needed because the social network (whereby employees and all their social relations form a solid network) is an effective means of transferring tacit knowledge (Nahapiet and Ghoshal 1998; Hansen 1999; Ipe 2003).

Until now, no articles studying the impact of social networks on safety knowledge sharing in the construction industry have been found, and many studies have only focused on general knowledge with regard to social networks, without thinking about them in connection to safety knowledge in the construction industry. For example, Chay et al. (2005) indicate that trust between two persons and differences in language and gender can affect knowledge sharing to a great extent. Dan (2003) shows that reward, team spirit, a culture of trust and leaders' behavior affect knowledge sharing. Brass (1995) considered that the similarity-attraction paradigm is an important theory of knowledge sharing which can make employees' sharing of knowledge much easier, and this has been shown in aspects of education, age, gender, reputation, job, and so on. In addition, Allen (1977) found that the distance between two employees' desks influences the probability of their sharing knowledge, the distance of 6 feet making it 4 times more likely than when the distance is 60 feet. In other words, Allen indicates that the shorter the distance between two employees' desks, the higher the probability of sharing knowledge. Elzarka et al. (1999) indicated that many of the safety standards and regulations for construction activities are vague, ambiguous, and inconsistently categorized. At the same time, safety knowledge and experience gained by a company's personnel is not utilized in an organized and efficient manner. Sharing of knowledge and experience from past projects will improve the performance of current and future projects.

2. Research Methodology

Based on a literature review and expert interviews, this study investigates ten types of construction employees: project managers, engineers, safety officers, foremen, electricians, welders, mechanics, scaffolders, woodworkers and masons, who all have a close relationship with or considerable influence on construction safety.

The concepts of foreman, engineer and gangmaster are often confused in the Chinese contexts. Even employees with same title very often do different work on different construction sites. Aiming for accurate selection of the objects for investigation, and to make sure these concepts are easily understood in cultures different from the Chinese construction industry, this study defines these three positions as follows.

1. An engineer is an employee who mainly does interior technical work in construction projects, including compiling construction organizational design, resolving technical problems in the process of construction, filling out records of techniques, and so on.
2. A foreman is a special kind of engineer. They take charge of the organizing and constructing of part-to-item work. A foreman's main responsibility includes leading in terms of technique, quality, schedule and safety in the construction process of professional work; following the project manager's orders in professional work; taking account of the work completed; and so on.
3. In China, a gangmaster is an employer or agency providing laborers for construction projects, and his main work includes taking primary charge of the technique, quality, schedule and safety of his group's work; managing his group workers; tracking his group workers' work; explaining safety techniques to his group workers; and so on.

The name-nominated method was employed in this study to ask a core question: To whom would you turn if you encountered a construction safety problem in your work? Respondents were asked to choose two people and write down these two individuals' job titles and their most important relationship (choosing from family, relative, good friend, friend, colleague, supervisor, subordinate, master, townee and classmate). The frequency analysis method was employed to study the selection information of all the relationships, and the logistic regression method was used to find the main factors. Lastly, this study adopted the Graphic-Method of social network to display safety knowledge sharing network based on job position on the construction site.

About thirty students from the author's University helped to conduct this questionnaire investigation, and many of the questionnaires were filled in via face-to-face interviews because many of the workers had insufficient education to be able to fully understand the questionnaire. The study involved sending out 330 questionnaires to 27 construction sites in Beijing; copies were returned by 267 respondents, including 21 project managers, 23 engineers, 24 safety officers, 21 foremen, 25 gangmasters, 28 electricians, 26 welders, 22 mechanics, 29 scaffolders, 28 wood workers and 20 masons. The collected information has been processed and findings are discussed in the sections below.

3. Distribution of safety knowledge sharing objects of construction employees

In the Chinese mainland, the people consulted for safety knowledge are mainly construction workers' supervisors and colleagues; the former represent 38% of all the people being consulted, and the latter account for 29%. At the same time, the proportions of master, townee and classmate among all the people consulted are 2%, 2% and 0.4% respectively (Figure 1)

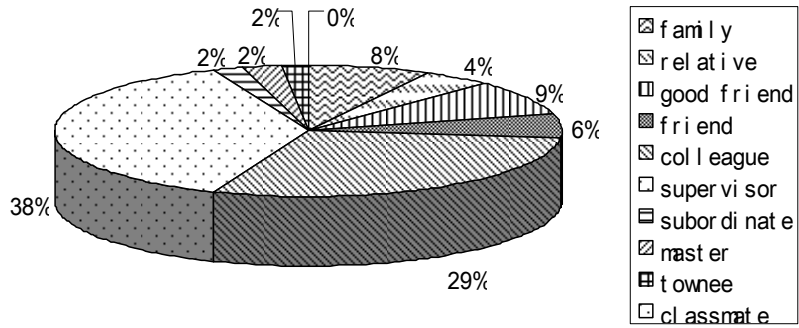


Figure 1: Distribution of people consulted by construction employees for safety knowledge

This study further analyzed the distributions of the different types of people consulted according to work type, age, education and tenure (from Figures 2 to 5).

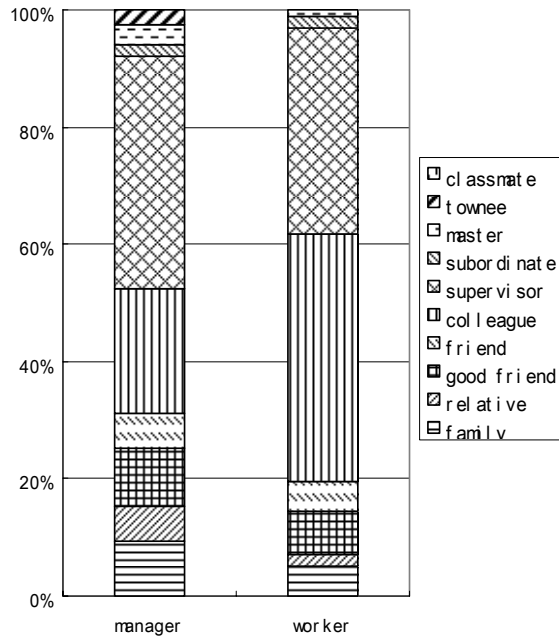


Figure 2: Comparison between workers and managers on people consulted for safety knowledge

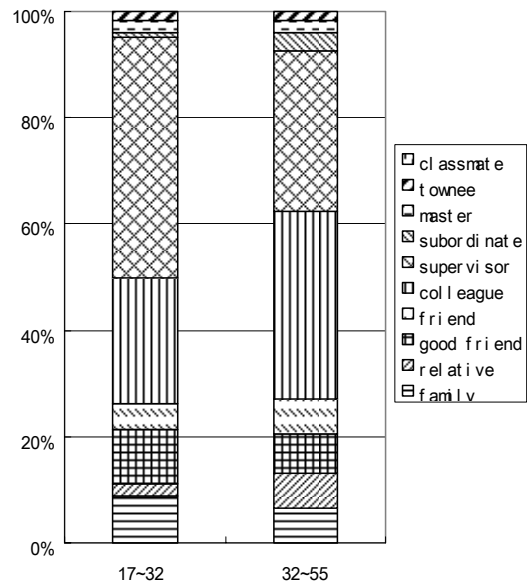


Figure 3: Comparison between young and old employees on people consulted for safety knowledge

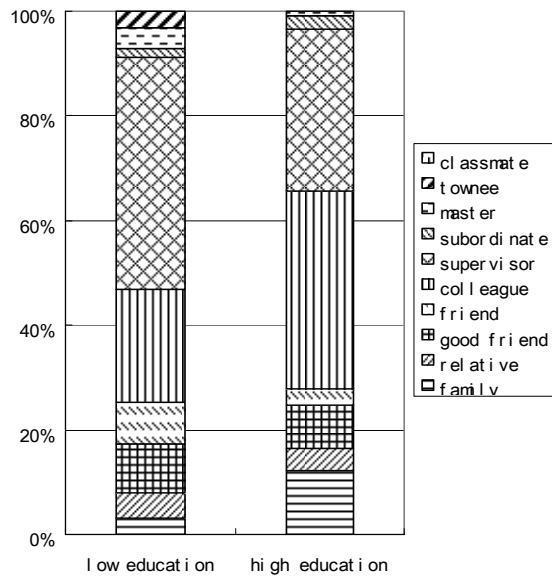


Figure 4: Comparison between more and less educated employees on people consulted for safety knowledge

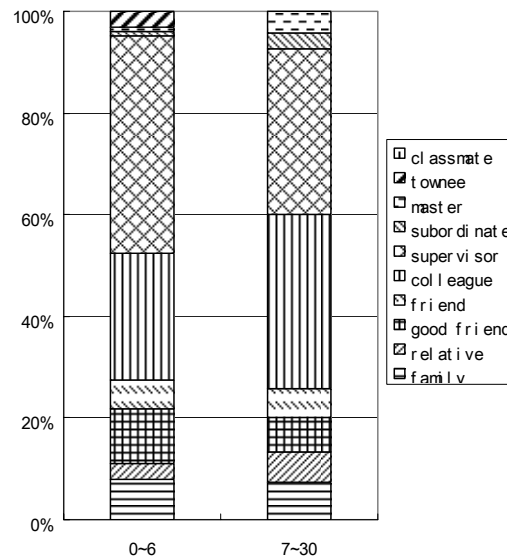


Figure 5: Comparison between new and senior employees on people consulted for safety knowledge

The findings show that:

1. Managers are more likely than workers to be selected by colleagues as consulting objects.
2. Younger employees are more likely than older ones to select their supervisors as consulting objects. At the same time, older employees are more likely than younger ones to select colleagues as consulting objects.
3. Supervisors are more frequently selected as consulting objects by less educated employees than by more educated ones. However, colleagues are less frequently selected by less educated employees than by more educated ones.
4. Supervisors are selected as consulting objects by new more often than by senior employees. At the same time, new employees select colleagues as consulting objects less than senior employees do.

From the above, we know that the construction employees' demographic factors, e.g. age, education and tenure, separately affect the selection of their consulting objects for safety knowledge. However, because young, less educated and new employees all prefer to consult their supervisors with regard to safety knowledge, this study further adopts the logistic regression method to assess the degree of influence of these factors (Tables 1 and 2).

Table 1: Logistic regression of the supervisor as a dependent variable

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	Education	-.346	.133	6.795	1	.009	.707
	Constant	.419	.370	1.283	1	.257	1.520
Step 2(b)	Education	-.348	.132	6.948	1	.008	.706
	Tenure	-.055	.022	5.963	1	.015	.947
	Constant	.860	.413	4.343	1	.037	2.364

Table 2: Logistic regression of the colleague relationship as a dependent variable

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	Work type	-.878	.290	9.161	1	.002	.415
	Constant	-.483	.209	5.349	1	.021	.617

The following results are obtained from Tables 1 and 2.

1. The education and tenure of construction employees have a negative influence on their selection of supervisors as consulting objects with regard to safety knowledge. This is to say, less educated and low-tenure employees clearly prefer to ask their supervisors for safety knowledge, and other factors have no obvious influence.
2. The work type of construction employees has an obvious influence on the likelihood of their selection of colleagues as consulting objects regarding safety knowledge. This means that colleagues are selected as consulting objects considerably more by managers than workers.

4. Safety knowledge consulting networks in construction projects

It has been shown that work relations come before all others as consulting objects in the construction industry. Aiming to reveal a more accurate picture of safety knowledge sharing in the construction industry, this study further explores safety knowledge sharing networks based on job positions.

The job positions of interviewees and their consulting objects were ascertained through the name-nominated method in the questionnaire, and a safety knowledge sharing network was then drawn up. Because the job positions selected by interviewees were too many to show in the figure, this study uses the cluster analysis method to divide all job positions into major and minor kinds, and only the major kind of job position is shown in Figure 6. However, some minor job position selections are necessary and significant, so they were plotted as dashed lines. In addition, “project manager” in Figure 6 includes project managers, deputy project managers and project safety managers.

The arrows in Figure 6 denote the direction of consulting behavior with regard to safety knowledge, and the percentages close to the arrows mean the proportion of that kind of consulting object in relation to all the consulting objects of a specific job position of interviewees. The percentages under job positions refer to the proportion of that type of interviewee selecting the same type of employee as a consulting object.

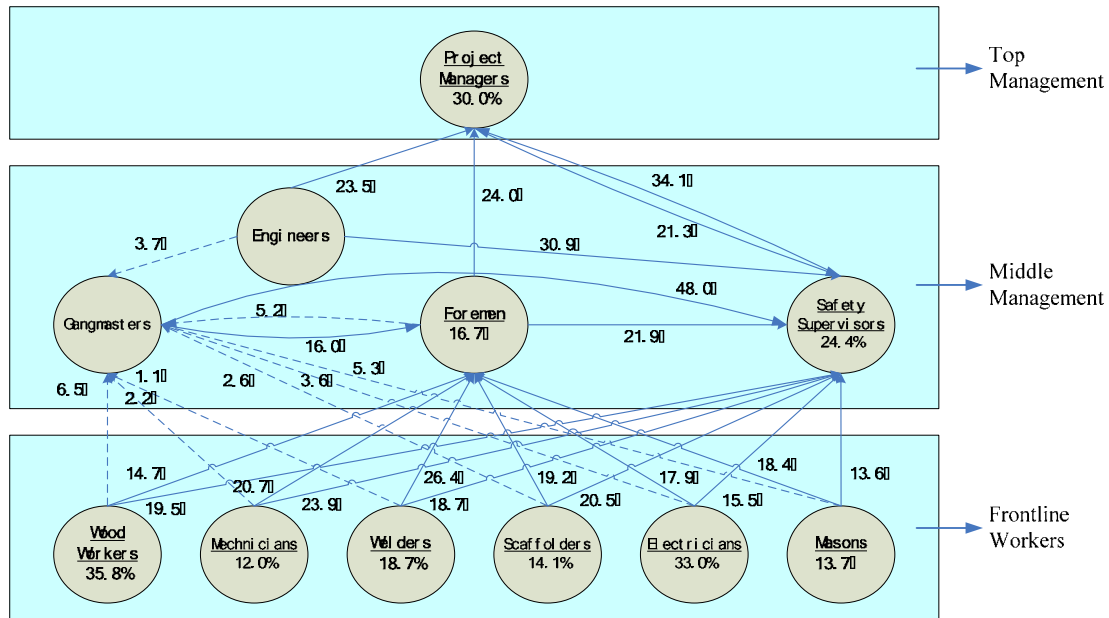


Figure 6: Safety knowledge consulting network based on job position in a construction project

The following results are obtained from Figure 6:

1. The safety officer is the most important consulting object of all the job positions. The proportions of wood workers, scaffolders, mechanics, welders, electricians and masons who would consult a safety officer are 19.5%, 20.5%, 23.9%, 18.7%, 15.5%, and 13.6% respectively. Also, the proportions of project managers, engineers, foremen and safety officers who would consult a safety officer on safety knowledge are 21.3%, 21.9%, 30.9% and 24.4% respectively.
2. The foreman is also a very important job position in terms of safety knowledge, and foremen are consulted by most workers. The proportions of wood workers, scaffolders, mechanics, welders, electricians and masons who consulted their foremen are 14.7%, 19.2%, 20.7%, 26.4%, 17.9% and 18.4% respectively.
3. A project manager is critical in the whole safety knowledge consulting network, and safety officers, engineers, foremen and project managers often consult project managers, in the following proportions: 34.1%, 23.5%, 24.0%, and 30.0% respectively.

4. Gangmasters are seldom consulted by construction employees, with proportions between 1% and 7% for all job positions, which is far below the frequencies of consulting foremen and safety officers.

5. Discussion

Given the above characteristics and the phenomenon of safety knowledge sharing in the Chinese construction industry, the study now discusses the reasons and measures.

5.1 Demographic factors clearly affect the selection of consulting object

Whether demographic factors influence the selection of knowledge sharing objects has been discussed in previous studies. Tang (2000) indicated that the job, tenure and age of employees in the finance industry have positive relations with knowledge sharing attitude (Tang 2000). Xiahou (2000) found that junior and young employees in the finance industry usually have lower motivation with regard to knowledge sharing (Xiahou 2000). In contrast, Liu's (2002) research showed that the gender, age, education and marital status of employees in the tourism industry have no relationship with knowledge sharing (Liu 2002). Cross et al.'s (2001) investigation in the US also revealed that age, education, and tenure of employees affected the selection of consulting objects (Cross et al. 2001).

This study found that while the education and tenure of employees in the construction industry have an obvious influence on their selection of their supervisors as consulting objects in terms of safety knowledge, work type and age do not. In contrast, the work types of employees have an obvious influence on selecting their colleagues as consulting objects, but education, age and tenure do not.

From the above research, there are two problems which have to be discussed. The first is why different research has yielded different results on the same scientific problem? There may be two reasons for this, one being that the research objects were in different industries, and different industries' cultures will affect knowledge sharing behavior. In addition, construction is a project-based industry, in which people who work on one project may not see each other again in other projects. This influences who you can consult on a project. The other possible reason is that Cross et al. (2001), Xiahou (2000), etc. did not consider the characteristics of knowledge sharing objects, which actually prove to have great influence on the selection of knowledge sharing objects. The second problem is related to why work types, education and tenure have an influence on the sharing objects of safety knowledge in this study. The reason may be that new employees are not familiar with their colleagues, and supervisors are seen as having more authority and experience than others. Highly educated employees have higher status in a project and therefore feel more confident than less educated employees. Construction workers in China are mostly farm workers who regard their kin relationships and geographical affinities much more highly than managers, so it is understandable that they consult their colleagues much less than managers. Based on the above discussion, some suggestions can be made to improve safety knowledge sharing, such as by strengthening supervisors'

responsibilities for safety training for new and less educated employees, and reinforcing team training for workers.

5.2 Gangmasters should play an important role in safety knowledge sharing

The work and safety management system is shown in Figure 7, in which the solid line means work affiliation and the broken line means safety supervision relationship.

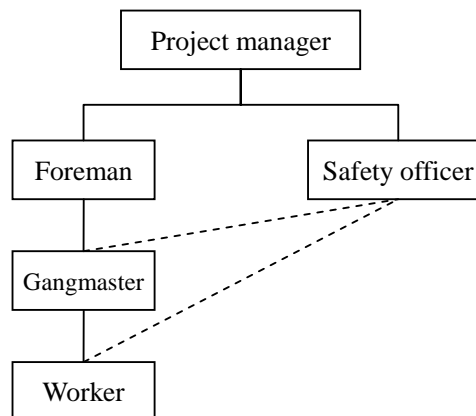


Figure 7: Work and safety management system in construction projects in China

From Figure 7, it can be seen that gangmasters are of great importance and directly command workers. Usually, a construction company needs a gangmaster's support to manage workers (Hao 2006). Generally, employees ask their supervisors if they have work-related questions, but this study found that workers seldom consult their gangmasters about safety knowledge. There may be two reasons for this, one being that gangmasters have a low level of professional knowledge and lack safety knowledge (Huang 2001), the other being that a gangmaster is a labor contractor or agent of the labor contractor who is the workers' employer, and thus has a tentional relationship with them.

As a result, this study tentatively puts forward some suggestions, including emphasizing the gangmasters' safety responsibilities in labor subcontracting, increasing safety training for gangmasters, and inviting gangmasters' involvement in safety meetings and the designing of safety plans.

6. Conclusion

The main conclusions to be drawn from this study are as follows:

1. Demographic factors obviously affect the selection of consulting objects. More specifically, the education and tenure of employees in the construction industry have an obvious influence on the

selection of supervisors as consulting objects with regard to safety knowledge, but work type and age factors do not. The work type of an employee has an obvious influence on whether or not they select their colleagues as consulting objects, but education, age and tenure do not.

2. The project manager is crucial in the whole safety knowledge consulting network, and is mostly selected as a consulting object by middle managers in construction projects.
3. Gangmasters should play a more important role than before in safety knowledge sharing, since they are the direct employers of workers and thus have a great influence on their behavior. However, workers seldom consult their gangmasters on safety knowledge, so gangmasters' effect on safety knowledge sharing should be reinforced.

7. Acknowledgement

Appreciations go to the Natural Science Foundation of Beijing (Grant No. 8072015), Natural Science Foundation of China (Grant No. 70172005 and 70572007) and National Science and Technology Planning Project (2006BAJ01B04-03) for their continuous supports.

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