

An Investigation of Practices and Attitudes to Quality in Large Chinese Construction Firms

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Abstract

Toyota is one of the most admired automobile manufacturers in the world, and is well known for its high-quality cars. This study begins with an overview of Toyota's quality practices, to uncover the secret behind its success. Toyota's ability to produce high-quality products can be credited to its employees' practice of not allowing defects to pass on to the next station (*jidoka*), as well as to its team-oriented forms (such as the company-wide quality circles), and the firm's culture of encouraging the workforce to expose problems in the process as much and as early as possible. These concepts appear to have been introduced by construction professionals into their day-to-day project management tasks. However, little is known about the extent of such practices and the attitudes towards quality present in the Chinese construction industry. This study draws on surveys and interviews of building professionals in China to investigate three central issues: (1) the extent to which the *jidoka* concept is implemented, (2) the workforce's current attitude and commitment to quality, and (3) how the quality circle (QC) concept is established and operated within Chinese construction firms. The results show that, in general, the basic concepts of *jidoka* have been implemented in large Chinese construction firms. It also reveals that the attitude side of quality management, such as forming QCs and continuous quality improvement, is generally lagging behind. The QC concept is not practiced as frequently or as actively in Chinese construction firms as in their Japanese counterparts. It seems that in these Chinese firms, the QC concept is not implemented voluntarily, but is largely driven by external factors, such as company requirements.

Key words: Toyota Way, *Jidoka*, quality circles (QCs), Chinese construction firms

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1. Introduction

Toyota is one of the most admired automobile manufacturers in the world, and is well known for its high-quality cars. Researchers from both Japan and abroad have attempted to understand the key elements in its successes. Efforts have been made to reveal the underlying culture and thinking of the Toyota Way (Liker, 2004; Liker and Hoseus, 2008), the Toyota production system, and the associated tools and techniques (Monden, 1998; Ohno, 1988). However, the recent massive recall incident has lead people to question the quality of Toyota cars, and some have interpreted this incident as evidence that Toyota has lost its way on quality. Yet this appears to be ungrounded, as in recent years Toyota has continued to win quality awards after quality awards (Liker, 2010). Nevertheless, it is worth making a timely return to the basics of the Toyota Way quality management principles and practices, and to reflect upon the implications for professionals both within and outside manufacturing (e.g. in construction). Toyota Way-styled quality management is particularly worth studying in the context of the Chinese construction industry, given that the Chinese construction workplace has never been completely free of quality problems. Construction quality in China has, however, improved over the years, which may be a result of the implementation of the mandatory construction supervision system (Yung and Yip, 2009) and Total Quality Management (TQM) practices (Tang et al., 2009).

2. Review of Toyota Way quality management

This paper begins with an overview of Toyota’s quality practices, to uncover the secret behind its success. Toyota’s ability to produce high-quality products can be credited to the adoption of *jidoka* which aims to eliminate possible defects from being moved downstream (Liker, 2004; Monden, 1998), to its team-oriented forms (such as the quality circles), and to the firm’s continuous improvement culture which encourages the workforce to expose problems in the process as much, and as early as possible. These three practices and their tools form the framework of this study (see Figure 1).

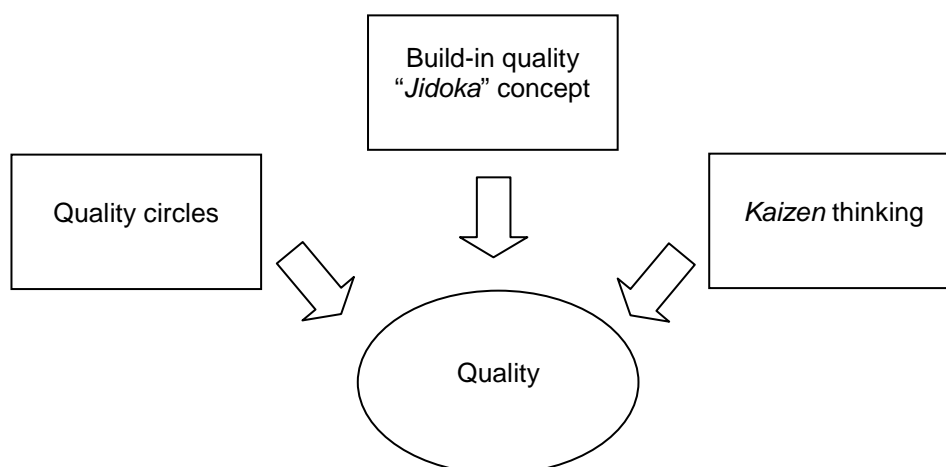


Figure 1: A model of the Toyota Way-styled quality management

2.1 *Jidoka* (build-in quality)

Jidoka is a Japanese word, meaning the practice of not allowing defects to pass on to the next station. It is commonly known as one of the twin pillars of the well-known Toyota Production System (Ohno, 1988), and is also in agreement with the principle of build-in quality (Liker, 2004). The principle of build-in quality prevailing at Toyota can be interpreted as “do it right the first time”, which is the overarching goal of TQM. Literally, *jidoka* represents a machine with human intelligence that has the simple task of detecting deviation from the standards and stopping itself to wait for help (Ohno, 1983; Liker, 2004; Monden, 1998). This concept has been extended to shop-floor process, where it is usually implemented using a rope cord. Any team member who judges the situation to be abnormal can pull the cord to stop production and indicate the location of problems. The team leader proceeds immediately to the site to investigate the situation and provide assistance. Under this principle, quality can be guaranteed to a large extent. It is worth mentioning that several preconditions need to be in place before embarking on implementing the concept of *jidoka*. These include: (1) a standardized process and detailed working instructions need to be created and thoroughly understood by workers, so that variations can be easily uncovered; (2) the quality of workers' skills: workers should have in-depth understanding of the process and be skilled in problem solving; (3) a supportive company culture: the company culture should see problems as opportunities; this would encourage workers to pull the cord when necessary to reveal quality problems; and (4) empowerment: empowerment from the top management also plays a vital role. Only when employees feel trusted and are empowered, will they pull the cord to reveal quality problems without fear.

In the construction industry, a culture of quality would preferably use an inspection period to fix occurring problems, rather than applying the Toyota Way's build-in quality or *jidoka* approach to eliminating defects in the first place. In this case, the principle of build-in quality could be understood as the adoption of preventative approaches, and as whether employees' attitudes towards quality parallel the “stop-and-fix” approach. The literature reports limited cases in the construction context where firms have employed preventative tools to produce better quality.

2.2 Engagement with *kaizen*: attitude and commitment to quality

According to Liker (2004), most of what is discussed today about continuous improvement generally comes from the interpretation of the Japanese practice called *kaizen*, which means continuous improvement involving everyone - top management, managers, and workers (Imai, 1986:xx). Brunet and New (2003) summarized three key characteristics of *kaizen*: (1) *kaizen* is continuous: this is the unique nature of the practice, viewed as a never-ending journey towards quality and efficiency; (2) *kaizen* is incremental in nature: in contrast to organizational or technological innovation, *kaizen* activities appreciate incremental improvement; and (3) *kaizen* is participative: it entails the involvement and intelligence of the workforce. In the *kaizen* philosophy, improvements in all areas of business serve to enhance the quality of the firm. The starting point for quality improvement is to recognize a need. In Toyota, each employee sees problems as an opportunity for improvement. Liker and Meier (2006) noted that employees only do this when the organizational culture focuses on

continuous improvement. The problem is that, in most firms, problems are perceived as failure, and are thus hidden rather than exposed. This is particularly true in some of the state-owned enterprises (SOEs) in China. Secondly, a non-blaming culture is also important. When fostered, employees are motivated to expose problems. Gradually, employees become willing to expose as many problems as they can.

2.3 Quality circles (QCs)

Quality circles are a vital part of *kaizen* at Toyota. As indicated by Liker and Meier (2006), unlike the American quality movement, QCs have never been a fad at Toyota. On the contrary, they have been an ongoing management tool for quality improvement. Historically, the first QC was developed and formalized in the early 1960s (Ishikawa, 1985). According to Ishikawa (1985), a QC is a small group that is voluntarily organized as a series of company-wide and participatory quality-control activities. People at Toyota choose to participate because they want to help improve the work area. Participation levels of over 80 percent are not uncommon in Japan (Liker and Meier, 2006). The purpose of QC activities, as outlined by Ishikawa (1985), includes: (1) to foster study groups in which foremen or workers study quality issues together; (2) to apply the results of their study to their workshops, so that more effective management and improvement of the work environment may be accomplished; and (3) to expand and enrich the personality of foremen and workers.

In the construction context, Rosenfeld et al. (1991) are among the few who had discussed the QCs in construction. Rosenfeld et al. (1991) listed a number of unique features of QCs in construction projects, and claimed that the special characteristics of project organization actually create even better opportunities for QCs than stable work-settings. This is because the former was always faced with the new lifecycle of a new project, while the latter may fall into an inevitable decay phase, as the most significant issues are tackled in a repetitive environment.

3. Quality practices in the Chinese construction industry

3.1 Status quo

Construction projects are subject to quality problems. The quality issues within the Chinese construction industry, in particular, are increasingly drawing the attention of researchers (see Yung and Yip, 2009; Zeng et al., 2003). Broadly, there are two views of quality in Chinese construction projects. On the one hand, a number of symbolic projects have helped China to win many accolades, and indeed these exemplary projects (such as the National Stadium, the Three Gorges Dam, and the Shanghai World Financial Centre) reflect the highest level of Chinese construction quality. Having observed these enormous achievements, Yung and Yip (2009) underlined that Chinese construction quality is expected to improve on a continuous basis, but at a decreasing rate as the economy develops. Moreover, Yung and Yip (2009) have highlighted that improved construction quality in China cannot be achieved without (1) the gradual implementation of mandatory construction supervision systems; (2) improved labour productivity; (3) the availability of resources, including machinery and labour; and (4) the use of more plant or machinery.

However, these exemplary construction projects do not represent the average level of the Chinese construction industry in terms of quality. On the other end of spectrum, there are the criticisms and complaints relating to poor construction quality, which appear to continue unabated elsewhere in the country. Poor construction quality was recognized as one of the critical problems in China in the 1990s (Chen, 1998; Lam and Cheng, 2004) and it is still a major problem (China Daily, 2010). There has been an alarming increase in fatal accidents caused by bad construction quality across the country. For example, a large number of schools and hospitals collapsed during the Sichuan earthquake in 2008, resulting in thousands of students being killed or seriously injured. In June 2009, a 13-storey building in the Lotus Riverside residential complex in Shanghai toppled, killing one worker. A recent tragedy includes the collapse of a bridge in northern China, at Harbin, which became at least the 18th collapse since 2007 (South China Morning Post, 2012).

3.2 How quality management works in China

Although quality management is increasingly practised in China, its implementation appears to be very uneven (Li et al., 2003). In China, construction quality is generally achieved under the supervision of (1) supervision firms (known as *jianli*), (2) relevant government authorities, and (3) the construction firms' own project management teams.

- Supervision firms: The roles and responsibilities of Chinese supervision engineers are in line with those of US design professional engineers (Wang et al., 2009). They act as the quality control team on site. However, Wang et al. (2009) have pointed out that the supervision professional's unclear scope of quality liability and safety liability in current laws, along with low level of competence seen in the practice of quality supervision, have become major causes of supervision liability risks, and ultimately would affect construction quality supervision.
- Government authorities and the building quality check programme: According to the Ministry of Housing and Urban-Rural Development (MOHURD, 2010), a number of quality awareness activities (e.g. "Safety Year activity") have been organized, to continue to stress the importance of quality awareness. Nevertheless the expected improvement is slow and disappointing.
- Construction firms: Attempts have been made by the Chinese government since the 1990s to implement the TQM framework, and to introduce ISO 9000 certification (Zeng et al., 2003). Tang et al. (2003) and Zeng et al. (2003) have pointed out that TQM has been accepted and applied in the construction industry in China, and there is a popular trend to obtain the ISO 9000 certification. Apart from that, the current status quo of quality management practices at Chinese construction projects - i.e., how quality management practices are carried out and how quality circles are operated - still remains unclear. This paper therefore attempts to bridge the gap and investigate the practices and attitudes of Toyota Way-styled quality management within large Chinese construction firms.

4. Methods

Guided by these objectives, this paper draws on surveys and interviews of building professionals in China to investigate three central issues: (1) the extent to which the build-in quality or *jidoka* concept has been implemented within large Chinese construction firms, (2) how the Quality Circles (QCs) are established and operated within Chinese construction firms, and (3) the attitude and commitment of the workforce towards quality.

A questionnaire survey was adopted to collect data for the purpose of assessing the first objective. The design of the questionnaire on build-in quality was underpinned by the works of Liker (2004). A five-point Likert scale was used, ranging from 1 (not at all) to 5 (to a large extent) for implementation, and 1 (not very important) to 5 (extremely important) for level of importance in the measurement of 9 actionable attributes derived from the *jidoka* concept. The questionnaire survey was conducted from February 2011 to May 2011. Questionnaires were sent to a mailing list of firms through the authors' contacts, which consisted of multiple sources, including the Chinese Construction Association. The list consists of more than 400 large Chinese construction firms. In total, 93 copies of the questionnaire were returned, representing a 24% response rate. A majority of the respondents were managerial personnel, including 34 general (deputy) managers (36.6%), 23 project managers (24.7%), and 15 engineers (16.1%). Respondents from these three groups have a good understanding of construction work, and are thus able to provide reliable responses to the questionnaires.

With respect to the second and third objectives, interviews and multiple site visits were carried out. 27 semi-structured (face-to-face) interviews were conducted. The interviewees consisted of 17 site staff and 10 management staff (see Table 1), all of whom were Chinese building professionals. They were also willing to be involved in the follow-up interviews, which were designed to explore in greater depth about how the QCs are operated within construction firms, and to understand the attitudes and commitment of their workforce to quality.

Table 1: Profile of interviewees and their firms

No.	Code	Designations of interviewees	Company Grade	Ownership
1	A	1 Project Manager	Premier	SOE
2	B	1 Engineer-in-Charge	Premier	SOE
3	C	1 Engineer-in-Charge, 1 Site Engineer, and 1 Commercial Manager	Premier	SOE
4	D	1 Project Manager, 1 Managing Director, and 1 Contract Manager	Premier	SOE
5	E	1 Project Director and 1 Deputy manager	Premier	SOE
6	F	1 Manager, 1 Head of Engineering Management Department, and 1 Project Manager	Premier	SOE
7	G	1 Vice President	Premier	SOE
8	H	1 Manager	One	SOE
9	I	1 Regional Manager	Premier	SOE
10	J	1 Project Manager	One	Private

11	K	1 Vice President	Premier	SOE
12	L	1 Site Engineer	Premier	SOE
13	M	1 Project Manager	Premier	Private
14	N	2 Project Manager and 2 Site Engineers	Premier	Private
15	O	1 Site Engineer and 1 Quality Engineer	Premier	SOE
16	P	1 Project Manager	Premier	SOE

Noted: (1) General contractors in China are graded into the Premier Grade (highest level), Grade one, Grade two, and Grade three and below. (2) SOE (state-owned enterprises) and private firms are two common forms of ownership of Chinese construction firms.

5. Results

5.1 Questionnaire survey

From Table 2, all the *jidoka*-related practices were scored less than 4 in terms of the implementation level. It can be seen that the importance values were generally rated higher by the respondents.

Table 2: Descriptive statistics of the *jidoka* concept in terms of the implementation and perceived importance

<i>Jidoka</i> -related attributes	Implementation			Importance		
	Mean	S.D	Rank	Mean	S.D	Rank
Employees are dedicated to provide “built-in” quality into every aspect of operations	3.67	1.020	5	4.32	.779	3
Preventing defective or uninspected assignments from entering the next process	3.70	1.014	3	4.43	.695	2
Rejecting defective materials, components and equipment	3.99	.910	1	4.46	.650	1
Employees are encouraged to seek support from their supervisors when something goes wrong at work	3.92	.797	2	4.22	.735	4
Employees are empowered to be responsible for quality	3.67	.920	5	4.18	.829	5
Kaizen activities on the topic of quality are conducted in the workplace	3.47	.991	8	4.07	.871	7
Employees who work in the same team meet on a regular basis to discuss quality problems and lessons learned	3.41	1.082	9	3.98	.867	9
Feedback about quality is routinely given by the employees	3.57	1.000	7	4.04	.879	8
Management treats quality problems as opportunities for employees	3.69	.939	4	4.14	.911	6

Some highly implemented attributes include:

- Rejecting defective materials, components, and equipment.
- Encouraging employees to report problems that occur.
- Preventing defective or uninspected assignments from entering the next process.
- Management treats quality problems as opportunities for employees.

These four attributes have mean values of 3.99, 3.92, 3.70 and 3.69 respectively, which implies that quality management practices have been put in place within the responding firms. In the respondents' opinions, these attributes have all been crucial to improvements in the firms' performance. This is also reflected by the mean values given to the degree of perceived importance (see Table 2). However, under the principle of build-in quality, two less implemented attributes include "discussion of quality problems and lessons being learned" (m=3.41), "kaizen activities on the topic of quality are conducted in the workplace" (m=3.47), and "feedback about quality is routinely given by employees" (m=3.57). All these lowest-rated attributes showed that the quality culture in the responding firms has not yet been fully established, as employees and frontline workers seemed to less proactively discuss quality problems and lacking the "kaizen" mindset for engaging in meaningful and continuous quality improvement activities. In addition to that, the relatively low mean values given to these three were partly due to the pressure of tight schedules; employees' time is compromised, and thus they were left with limited time for quality-control activities.

5.2 Interviews

5.2.1 Workforce's attitude and commitment to quality

Poor attitude and commitment to quality

Quality problems that emerge repeatedly in day-to-day operational activities are important for signifying improvement opportunities. However, a large number of interviewees claimed that quality continuous improvement activities were completely absent from their firms. They also reported that neither employees nor frontline workers have the *kaizen* mindset. This corresponds to the survey finding, in which a few softer *jidoka*-related activities received low ratings from the survey respondents. The largest challenge - cited repeatedly by many interviewees - was that the rapidly expanding construction industry in China takes in a large number of unskilled construction workers who have fairly low levels of awareness of and commitment to quality. The majority of frontline workers in China are migrant workers registered with various labour-only subcontractors. The engineer-in-charge from Firm C revealed that: "It is really hard to manage the quality of such workers. Too often, they kept silent about damage or results of poor workmanship."

This was confirmed by a number of interviewees, such as a manager from Firm H, who said: "Take wall plastering for instance. The quality of wall will be affected if the 'wet' treatment is not properly done, and this will lead to cracks in several months. The frontline workers knew that the cracks would not immediately be noticeable by the auditor, and so some irresponsible workers will be 'clever' and skip this essential step, and proceed to the next."

A manager from Firm H also commented that one recurring problem was responsible for the continuing problems at the construction site. Efforts were made to fight this, but do not seem to work well, as ultimately it relates to workers' working habits and attitude, which lack *kaizen* thinking.

Lack of a non-blaming culture

Culture has a huge impact on the quality problem-solving process within the firm. Most interviewees replied that when they encountered a problem, they certainly have to consider the consequence of surfacing it, instead of surfacing the root cause. In most cases, exposing problems will in turn bring potential economic loss. Moreover, the interviewees stated that in facing up to quality problems, some project managers were more concerned about who should take responsibility for problems, or else leaders from SOEs desire problems to be solved according to their own philosophy, such as “reduce major issues to minor ones, and minor ones to nothing”. Under such leadership, techniques such as the 5 Whys (means ask the question 5 times to reveal the root causes for the problem) have no place at all. If people do not look at problems as opportunities to build a better problem-solving system, they will then just take the shortest path to remove the symptom. Regardless of how much professional know-how and skills they possess, their wrong behaviours can deter all progress.

5.2.2 Quality circles

Given that the Chinese government is actively promoting the introduction of quality circles, it is not surprising to see that all the firms interviewed have had embarked on the quality route using QCs for quality improvement. However, in comparison with QCs in Japan, the QCs presently conducted in China’s construction industry tended to be characterised by some differences, which are highlighted in Table 3.

Table 3: Comparison of Chinese QC and Japanese QC in construction projects

	QCs conducted within Chinese construction firms	Japanese QCs activities (Imai, 1986; Ishikawa, 1985)
Quantities	<ul style="list-style-type: none">• One or two QCs were conducted within one project• No meetings to discuss the quality problems	<ul style="list-style-type: none">• A large number of QCs (e.g. per year)• Frequent meeting to discuss the quality problems
Enabler	<ul style="list-style-type: none">• External forces such as to fulfill the requirements and be eligible for the quality competition	<ul style="list-style-type: none">• Employees recognize the potentials for improvement
Approach	<ul style="list-style-type: none">• Top down approach: Project manager determines a QC topic for his team to carry out	<ul style="list-style-type: none">• Bottom up approach: employees voluntarily participate in the QCs activities
Overall goal	<ul style="list-style-type: none">• Aim at “ad hoc” improvement if possible	<ul style="list-style-type: none">• Continuous and small improvement

(1) Quantities

According to the interviewees, QCs are not actively conducted at the project level, even though most responding firms are aware of its importance. Generally, one construction project only aims to foster one case of successful QC. An interviewee from Firm J explained that: *“It is good enough to have only one QC. This is because if more QCs are conducted,*

extra management efforts, as well as more human resources from different departments are needed, and perhaps more budget for it. We really do not have time and resources for this.”

Given that all the firms interviewed were large Chinese construction firms, they are expected to have widely-spread sites geographically and numerous projects going on at the same time. Fortunately, by the end of the year, construction firms may achieve multiple cases of successful QCs, as well as attain tangible results. In order to recognize the outstanding contributions to project performance and to give the QC participants the satisfaction of achieving their goals, a number of responding firms introduced award schemes to recognize excellence in QC achievements in their construction projects. What is more meaningful is that a number of successful QC cases were compiled, published, and circulated within the firm and between the projects, so that all employees can learn from the experience.

(2) Enabler

Today, specific requirements such as to conduct effective QCs in construction projects are indicated in the contract documents. Based on the interview results, the by-product of QC, namely employee motivation, was largely ignored. Conversely, the ultimate drive for them to carry out QCs has nothing to do with striving for excellence, but to simply fulfil the contractual obligations, or to use quality awards as the selling point to increase the likelihood of winning future projects.

(3) Approach

As Table 3 indicates, QCs in the Chinese construction industry are pre-dominantly conducted in a top-down fashion. Many of the firms interviewed pointed out that the project manager acts like a moral supporter, rather than a leader of the QC team, whereas the real efforts came from the project engineer who is in charge. Moreover, the interview findings suggest that some QC teams are inappropriate in terms of their structures, in that the frontline workers are often excluded. This implies that the QCs are limited to among the site personnel and the frontline workers may not even be aware of the existence of QCs throughout the project. One interviewee from Firm D explained that: *“It is close to impossible, at least at this moment, that our workforce could contribute their feedback and be participating in QCs. All in all, the quality of workforce is the biggest difference compared to their Japanese counterparts.”*

(4) Overall goal

Some respondents stated that they were currently struggling to define an appropriate QC problem to form a QC topic. For a number of projects that the research team visited, most have not yet identify a QC topic even though the QC team has been formed. A majority of the firms interviewed outlined that efforts have been made in searching for relevant problems in the hope of achieving breakthrough improvements. One interviewee from Firm M pointed out that: *“It is getting harder for us to choose a topic. Many have been investigated by colleagues or industrial practitioners. So far, our QC team has still not decided on what to*

work on. This perhaps is the reason why our project has progressed to almost half way but the QCs have not yet been formally kicked off.”

6. Discussion and conclusion

The Chinese construction industry and firms have been facing quality challenges for some time and are expected to face more of such challenges in the future. While many business organizations have become leaner and reliable as a result of the adoption of build-in quality principles, construction firms have not been affected by this to as great an extent. This study shows that quality management practices derived from *jidoka*, or principle of build-in quality, are vital and worth learning. It is clear that the *jidoka* approach to quality management do apply to Chinese construction firms. The results show that, in general, the *jidoka* approach has been implemented in large Chinese construction firms. The findings are consistent with Li et al.'s (2003) research, which indicates that the procedural aspects of quality management - i.e. “rejecting defective materials, components, and equipment”, “preventing defective assignments from entering the next process” - and other prevention means are already in place. This could be attributed to the fact that employees from the project team have followed the ISO 9001 guidelines (Zeng et al., 2003). On the contrary, the softer aspects of the *jidoka* approach - such as group meetings, discussion of quality problems, quality *kaizen*, and others - appeared to be less commonly conducted activities at the workplace. The implications for management here is that these less-implemented attributes should be recognized as weaknesses in terms of the implementation of the *jidoka* approach; hence they require immediate attention. Endeavours should be made as follows:

- greater empowerment should be given to employees, who should take responsibility for quality,
- teamwork on quality issues should be encouraged, i.e. quality circles should be formed to assist in quality improvement, and
- *kaizen* thinking should be embedded in the quality culture.

Furthermore, the study also reveals that employees' attitude towards quality shows inconsistencies. In the survey, one attribute, namely “employees are encouraged to seek support from their supervisors when something goes wrong at work”, was rated highly, perhaps owing to the fact that workers are surrounded by site engineers. However, in the interviews, a majority of the interviewees highlighted that this is not always the case. One possible explanation is that, in the Chinese construction industry, workers' attitudes and commitment to quality are mixed, and heavily depends on the quality of the crews that the construction firms have recruited. Nevertheless, it was pointed out that a majority of the workers are still far from their Japanese counterparts with build-in quality thinking, as these practices and concepts have evolved over time there and are a part of the firm's culture in Japan. In contrary, what is uppermost in the minds of the Chinese workers is how to get more work done per day for higher earnings. Worse, this encourages them to cut corners in their daily operations and leads them to neglect build-in quality in their operations. As far as these challenges are concerned, it will probably take a long time for the Chinese construction firms to develop a workforce with build-in quality thinking. Certainly, the labour-

only subcontractors should play greater roles in developing the workforce they supply to construction projects.

In the case of implementing quality circles, the results are also consistent with the studies completed by Rosenfeld et al. (1991), in which the QC in the project environments is different from the regular QCs in the manufacturing setting. In this context, the QC team should, for a start, take advantage of the uniqueness of each project and seek wider opportunities for improvement (Rosenfeld et al., 1991). Moreover, QCs were not practiced as frequently or as actively in Chinese construction firms. In addition, it seems that QCs were not implemented voluntarily, but were largely driven by company requirements. Therefore, management must realise that the true purpose of the QC is more than to simply fulfil contractual requirements; QCs should be integrated into the daily running of the companies or projects. QCs or other forms of *kaizen* should be embraced as part of the firm's culture and objectives. Likewise, management should facilitate participation in QCs with possible rewards, and more importantly, the frontline workers should be invited to participate given that they know better about the processes and are better able to identify the possible problems in their workplace.

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