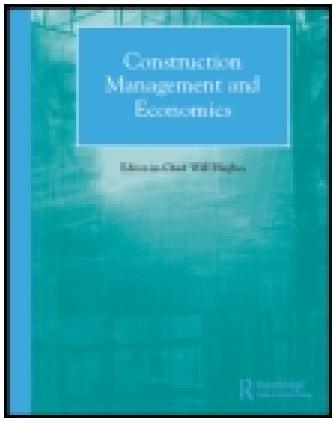

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Quest for continuous quality improvement for public housing construction in Hong Kong

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With mandatory implementation of the ISO 9000 quality system by the Housing Authority in Hong Kong, most construction firms there now claim to have initiated quality systems in their processes as defined in their quality manuals. In addition, an objective quality measuring yardstick, the Performance Assessment Scoring Scheme (PASS), has been administered by the Housing Authority of Hong Kong to monitor the performance quality of contractors. These two measures, coupled with the two other contractual requirements stipulating the use of mechanized formwork and precast facade units, are directed towards achievement of a desired quality standard. However, the PASS analysis has revealed that the general level of quality has not improved significantly and the expected continuous improvement in construction quality has not been realized over a specific time period. Quality appears far better on paper than does the actual work on site. This suggests that quality management in the construction setting is far more difficult to achieve than it is in other industries. This paper explores possible reasons for failure in the quest for quality in public housing construction, and proposes changes needed before the vision of continuous quality improvement can be realized.

Keywords: Public housing construction, quality management, ISO 9000, quality assessment

Introduction

The construction industry in Hong Kong has long been associated with poor quality (Tam and Tong, 1996; Kam and Tang, 1998). New construction technology, such as the mechanization and industrialization of construction that could bring about quality, depends on the coordination of many operators and phases of work, responsibility sharing between managers and operators, activity sequencing, elapsed time between installation and use, and the number of direct operators and their qualifications (Cirovic and Lukovic, 1998). Usually, the developer, through a contract, stipulates that a contractor should finish the work within a specified period of time, at an agreed price and at a certain standard of workmanship. Therefore a contractor must attain the cost level as planned, meet the scheduled deadlines and achieve the required quality level. However, these all seem to be conflicting goals running in three different directions (Figure 1). What the management should do is to maintain a balance among the three. In addition, most people in the construction industry consider that 'quality versus time versus cost' is a zero sum game and, hence, whenever there is a choice among the three, usually quality is the first to be sacrificed. Many production personnel focus only on immediate problems and view their top priorities as meeting the production schedule, quota and cost targets. Only after achieving these objectives will they give some consideration to quality (Baxendale and Burrell, 1997; Dale *et al.*, 1998). In the construction industry, 'cost' directly burns up the profit of a contractor, 'time' can be converted into costs by liquidated damages and time dependent preliminaries,

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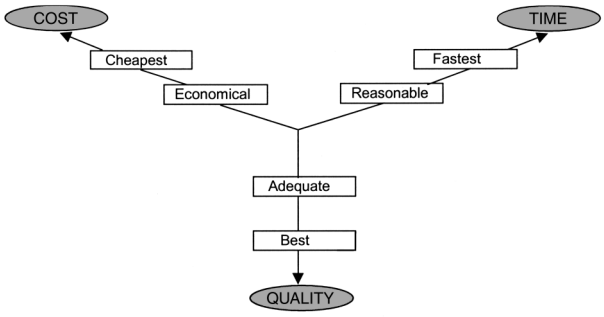

Figure 1 The eternal triangle between cost, time and quality (reproduced from Kharbanda *et al.* (1987))

while 'quality' alone does not, in the short term, represent cost to a contractor if the poor quality work slips through inspections unnoticed.

Thus, quality movements in construction largely are customer driven, and are not initiated by the contractors themselves. Though there are many stories of the successful adoption of ISO 9000 in the manufacturing industry, the application of ISO 9000 in the construction industry is not promising. The recent discovery of shortened pile foundations in some of the Airport Railway Station projects in Hong Kong reveals the need to review the quality system currently in use by the construction industry.

The major objective of this study is to investigate the current quality management tools adopted by the Housing Authority and try to unveil the hidden hurdles in implementing these quality improvement measures. Existing approaches will be reviewed, reasons for failure in the quest for quality in public housing construction will be explored and recommendations for continuous quality improvement will be proposed.

Quality management in public housing construction

There are four approaches adopted by the Housing Authority of Hong Kong that aim to improve the quality of public housing construction since the early 1990s: 1, mandatory requirement of ISO 9000 quality assurance certification scheme in 1992; 2, implementation of an objective on-site quality evaluation system: performance assessment scoring scheme (PASS) in 1990; 3, mechanization of construction by mandating contractors to use large panel form, jump form or slip form methods; and 4, prefabrication of facade units, stairs and flooring units. The first requires contractors to be ISO 9000 certified before qualifying them for tender. The second rewards contractors with high PASS scores by granting them more tendering opportunities. The third and fourth are part of the contractual requirements. Despite the above efforts, the quality of public housing, in fact, has not improved significantly in recent years.

PASS

PASS has been developed to measure performance output directly against defined standards and to provide a fair method for comparing the performance of individual contractors. At a particular sampling location, the construction work that is to be assessed is judged in terms of its compliance with pre-defined standards. The assessment is a simple yes/no exercise. There is no provision for partial attainment of standards. To give a fair assessment, several locations are sampled to give an even measure of the overall standard. The sampling spots are generated randomly by computers from all possible spots defined in the PASS manual. PASS is divided into three types of measurement: 'output', 'input', and 'maintenance' assessments. The input assessment deals mainly with management capability, organization and communication issues. The output assessment evaluates the quality of the final output of building works. The maintenance assessment is carried out during the maintenance period, which is aimed at checking how the building functions after occupation. The combined input and output assessments will give a composite score which will be used for consideration of tender opportunities, and while the weightings of the output and input assessments are 75% and 25%, respectively. Maintenance assessment is used as a supplementary tool for decisions concerning penalizing contractors. Among these three measurements, the output assessment is considered the most important and most heavily weighted yardstick. It directly measures the quality of products. In order to give a more 'direct' evaluation, output assessment is used in this paper to assess contractor performance, to avoid dilution created by including supplementary factors.

The PASS output assessment looks at the following aspects:

(1) *Structural work.* This aspect of output is allotted 35% of the total score. Factors measured in this aspect are falsework, formwork, reinforcement, concreting practice, concrete quality and finished concrete with special quality standards and tolerance.
(2) *Architectural work.* This aspect of output deals mainly with components and finishing. The 35% allotted to architectural work is distributed among several factors, including floor, wall, windows, installation of components, plumbing installation,

structural window openings and application of spatterdash with specific quality standards and tolerances.

(3) *External work*. This aspect of output is allotted 10% of the total assessment. Factors covered by this aspect include roads, emergency access, footpaths, pedestrian areas, drainage and covered walkways, with specific quality standards and tolerances.

(4) *General obligations*. This aspect is concerned with the contractor's duties and responsibilities under the contract. The 20% allotted for this aspect is assessed with respect to factors like safety and general obligations with specific quality standards.

Every month a PASS assessment is conducted by the Housing Authority for each project. Before the assessment is undertaken, the contractor is notified not more than one half day in advance. Assessment elements, such as the levels of flooring, are randomly selected by using a computer program. The locations of all possible spots are defined in the PASS manual. A 'hardline' assessment approach (i.e. assessing and grading against the worst case as found in the randomly selected spot) is adopted for the measurement. The results should give the contractor no excuse for deviation from the specifications (Housing Department, 1996).

Analysis of PASS

Individual monthly PASS output scores of 150 public housing projects representing a total of 41 building contractors for the period between July 1994 and June 1998 were collected. Additionally, some supplemental data, such as the overall monthly average PASS output scores for the period between 1992 and 1994, has been obtained and used for the study of overall trends.

Monthly PASS output scores

Figure 2 shows the monthly change in average PASS output scores, the target quality scores, and the lower score thresholds (see definitions in Appendix). It can be seen that the monthly average scores varied from the target quality scores in the year 1992, and then the gap between the two scores narrowed beginning in 1993. The gap suddenly increased between January and May of 1995 when the Housing Department decided to tighten the rules and introduce new measures. The average scores have remained stable since January of 1996, with most scores ranging between 80 and 83.

Comparison among contractors

The monthly PASS output scores of each contractor for the period between July 1994 and June 1998 are averaged. An 'average PASS output score' for each contractor is derived as shown in Figure 3. The dispersion of these contractors' PASS scores from the target quality score is summarized in Table 1, which shows that the number of contractors achieving a quality standard close to the target quality score is relatively small. Only 14.6% of the contractors perform within a 10% range of the target quality score.

Table 2 reveals that the two large contractors (5%) undertook 44 of the 150 contracts (or 30%) between July 1994 and June 1998. An interesting fact is that the two large contractors tend to have

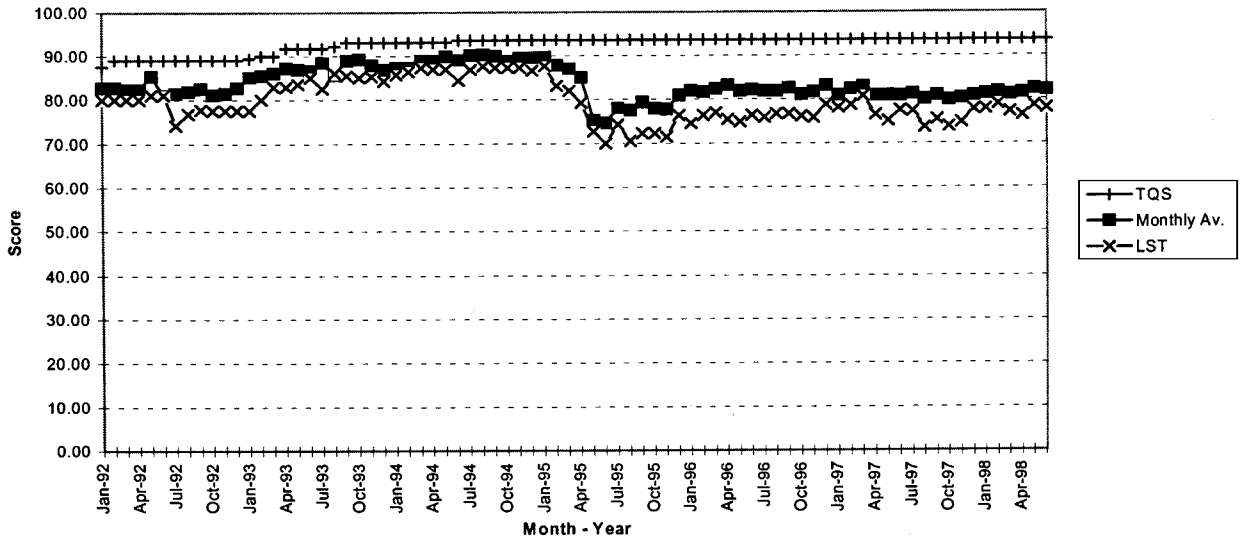

Figure 2 Monthly average PASS output scores for January 1992–June 1998)

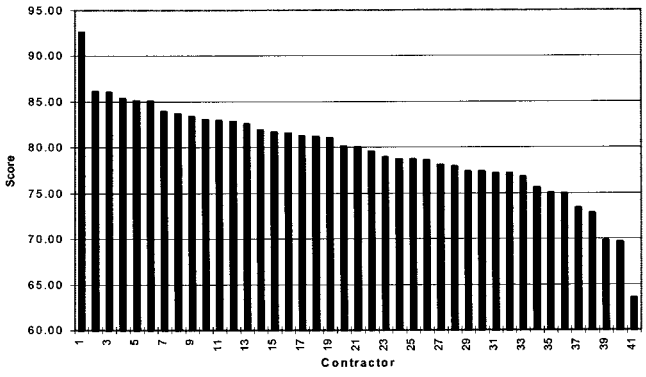

Figure 3 Average PASS output score for contractors for 1994–1998)

higher PASS scores than other contractors. It indicates that only a few contractors, especially the large ones, can achieve the desired quality levels, and the majority of the contractors are still some distance away from desirable quality standards. Therefore we can conclude that the general level of quality 'for most contractors' has not reached the standard, and a sustainable quality improvement has not yet been realized.

Thus PASS has two major shortfalls. (i) When only a few contractors, especially large ones, can achieve the specified quality standard and the remaining contractors fall far below the performance criteria, a 'small number condition' occurs (Lane and Nyen, 1995; Petersen, 1995). Since only this small number of contractors can provide the desired quality skills, the client has few contractors with whom to bargain and is forced to accept a quality standard below the desired quality target. Slack in quality performance by the remaining majority of poorly performing contractors may occur. Even those contractors with high performance have little incentive to further improve. (ii) During a boom period, there are many job opportunities outside the public sector and contractors will show less interest to win the chance to bid for public housing contracts. This is the case in Hong Kong with a booming construction market from 1994 to 1998.

Table 1 Dispersion of contractors' PASS scores from the target quality score (TQS)

Range (TQS=93.70 as from June 1994 onward)	Number of contractors
Within 5 % of the TQS (i.e. Score > 89.02)	1 (2.4 %)
Within 10 % of the TQS (i.e. Score > 84.33)	6 (14.6%)
Within 15 % of the TQS (i.e. Score > 79.65)	21 (51.2%)
Within 20 % of the TQS (i.e. Score > 74.96)	35 (85.3%)
Within 25 % of the TQS (i.e. Score > 70.28)	38 (92.7%)
Within 30 % of the TQS (i.e. Score > 65.59)	40 (97.6%)
Within 35 % of the TQS (i.e. Score > 60.90)	41 (100 %)

This analysis shows that just granting higher tendering opportunity to contractors bearing higher PASS scores is not adequate to stimulate quality drive. The incentive needs to be in the form of tangible reward. An example is Singapore. It has developed a premium scheme which provides a tendering advantage of up to 5% (or S$5 million, whichever is lower) in public sector building tenders to those constructors who consistently achieve good quality work (Lam *et al.*, 1994).

Review of ISO 9000 QA scheme

Figure 4 gives the average PASS scores from 1991 to 1998, and the PASS scores have not increased signi-

Table 2 Number of projects undertaken by individual contractors (1994–1998)

Contractors		Proportion of all contractors		Projects conducted by a contractor		Proportion of total projects		Size of contractor
No.	Rank		(%)		(%)		(%)	
1	1	2.4	(2.4)[a]	23	(23)	15.3	(15.3)	Large
1	2	2.4	(4.8)	21	(44)	14.0	(29.3)	Large
1	3	2.4	(7.2)	10	(54)	6.7	(36.0)	Medium
3	4–6	7.3	(14.5)	8	(78)	5.2	(51.6)	Small
2	7–8	4.9	(19.4)	6	(90)	4.0	(59.6)	Small
2	9–10	4.9	(24.3)	4	(98)	2.7	(65.0)	Small
7	11–17	17.1	(41.4)	3	(119)	2.0	(79.0)	Small
7	18–24	17.1	(58.5)	2	(133)	1.3	(88.1)	Small
17	25–41	41.5	(100)	1	(150)	0.7	(100)	Small

[a]Figures in parentheses indicate the cumulative sum.

ficantly since implementation of the mandatory QA certification scheme in 1992.

Tam (1996) reported that the setting up costs of the certification scheme were HK$1–3 million and the average running cost was 0.2% of the contract value. Additionally, since the implementation of the scheme, tonnes of paper have been spent on the documentation system. However, Tam and Tong (1996) stated that the expected quality improvement goal has not been realized. Since the Housing Authority of Hong Kong has mandated contractors to be ISO 9000 certified, contractors considered the certification exercise to be a gateway for inclusion on the tender lists. Hence, commitment to quality was not genuine. Tam and Tong (1996) came up with the following recommendations.

1. Clients need to realize that QA is a way to quality but not the end.
2. The ISO 9000 certification exercise should not provide a hurdle for inclusion on tender lists. Instead, contractors should be encouraged to adopt the system voluntarily. They should be commended and rewarded for their effort at quality enhancement initiatives, the process and products, and not by the process alone.
3. Quality concerns should be aroused by educating the public and contractors. Genuine contractor commitment to quality management is preferred to enforcing the scheme through administrative power.

The above investigations show that use of the described quality management systems does not result in the desired continuous quality improvement. To study the reasons for the difficulties, the authors have carried out a structured survey that aims to study the factors affecting construction quality.

A survey to unveil factors determining construction quality

In order to study the factors affecting construction quality, a structured survey has been carried out. 21 contractors who concentrate on the public housing construction market were contacted, and 12 were willing to cooperate. 120 construction management personnel were interviewed, covering 30 public housing construction sites. Data were collected during the period from October 1997 to May 1998. Interviewees included 61.1% quality control engineers, 11.1% site managers and 27.8% general foremen and site supervisors.

The factors studied cover the areas of the industry structure, market, management, quality assurance (QA) system, culture and so on. They include: (a) the competitive tendering approach; (b) the subcontractor system; (c) cooperation of project parties; (d) adequacy of project duration; (e) labour turnover; (f) proportion of certified skill labour and training provided; (g) working environment on site; (h) overtime work for labour; (i) site supervision; (j) project complexity; (k) commitment to quality and experience of the project management team; and (l) conscientiousness of labour.

The interviewees were asked to provide their opinion on the effect of each identified factor towards quality by scores from 1 to 5, where '1' represents the least important and '5' the most important.

Results and analysis

To determine the relative ranking of the factors, these scores were then transformed to importance indices based on the formula (Kometa *et al.*, 1994)

$$\text{Relative importance index} = \frac{\sum w}{AN}$$

where w is the weighting given to each factor by the respondent, ranging from 1 to 5 where '1' is the least important and '5' the most important, A is the highest weight (i.e. 5 in the study) and N is the total number of samples. The relative importance index ranges from 0 to 1. Table 3 shows the relative importance index of each identified factor.

Culture

The factor 'commitment to quality and experience of the project management team' is ranked first, with a relative importance index of 0.889, indicating that most people ranked this above '4'. This confirms the vital role of management in construction quality. Leadership (Rowlinson *et al.*, 1993), commitment (Arditi and Gunaydin, 1998), and developing the effective project quality plan and increasing technical and managerial efficiency (Abdel-Razek, 1998) are some of the aspects of management experience identified as having influence on quality.

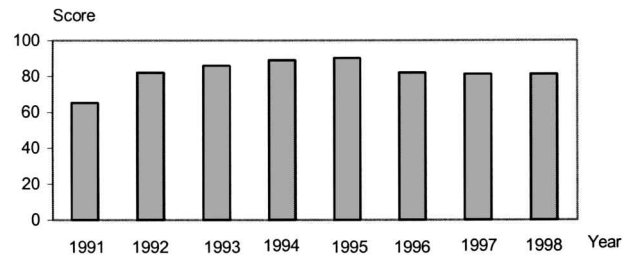

Figure 4 Average PASS scores from 1991 to 1998

Table 3 Relative importance index and rank of factors affecting construction quality

Rank	Factors affecting construction quality	Relative importance index	Problem centre
1	Commitment to quality and experience of the project management team	0.889	Culture
2	Conscientiousness of labour	0.844	Culture
3	Site supervision	0.822	QA system
4	Adequacy of project duration	0.778	Market
5	Labour turnover	0.778	Market
6	Project complexity	0.744	Project-specific
7	Working environment on site	0.722	Management
8	Overtime work for labour	0.711	Management
9	Proportion of certified skill labour and training provided	0.689	Market/Management
10	Subcontractor system	0.689	Structure
11	Competitive tendering approach	0.667	Structure
12	Cooperation of project parties	0.644	Structure

The respondents graded the factor 'conscientiousness of labour' second, with a relative importance index of 0.844. In the old days, Chinese tradesmen would feel ashamed if their work, or that of their apprentices, were not up to standard. However, the culture has changed. People in Hong Kong no longer care about the consequences of their product. This reflects the significant influence of culture has on quality. Although the ISO 9000 standard has been implemented by contractors contracting for public housing projects in Hong Kong, the quality culture has not yet improved. According to Cutcher-Gershenfeld *et al.* (1997), three stages of 'quality' development are classified.

Stage I : Selected, discrete programs — not fully integrated into organizational culture and systems.

Stage II : Widespread, coordinated mix of programs — but not fully integrated into organizational culture and systems.

Stage III : Widespread, coordinated mix of programs — fully integrated into organizational culture and systems.

Culture change for the acceptance of quality concepts is known to be a long journey. It may take years or even decades, i.e. analogue to Furnham and Bochner's (1986) acculturation curve: a 'quality acculturation curve' is constructed as shown in Figure 5, with feelings (positive or negative) towards quality plotted on the vertical axis and time shown horizontally. Stage I covers phases 1 and 2, while phase 3 and phase 4 correspond to stage II and stage III, respectively.

Phase 1 is a period of euphoria, when people are put in a state of honeymoon, pleasant excitement and wonderful hopes for quality. This corresponds to the inception stage of ISO 9000 when all contractors made a dash for it.

Phase 2 is a period of quality shock when employees face a change in their usual working procedures. A paper quality management system like ISO 9000, which can be installed more quickly than changes in human attitudes and culture, emphasizes protocol rather than culture. Accreditation schemes for ISO 9000 concentrate heavily on compliance with procedures, paying little or no attention to the human side of the system. On the other hand, as Wealleans (1998) mentioned, ISO 9000 provides the best example of 'branding for quality'. It gives a unique identity for the internal change program, deepening the 'quality' impact, and is important to the success of a quality venture.

Phase 3, acculturation, occurs when employees have slowly learned to function under the new quality environment. Here, a wide range of programmes and initiatives, often with formal internal champions, is acknowledged. In Figure 5 the growing positive feeling may be suppressed easily when people encounter obstacles or failures. That phenomenon bears a strong resemblance to the current situation in the construction industry of Hong Kong, the obstacles being an increase in paperwork and difficulties in managing the multi-level subcontracting system.

Therefore campaigns to promote quality are required regularly to restore and expand positive feelings. Stockdale (1997) claimed that people need to see successful models before they want to follow the same path. That requires good supporting ideas and phrases which will draw the employees' attention to quality. In addition to daily operative efforts, management must facilitate this modelling. This is particularly true in dynamic environments where the level of uncertainty is so high that transformation processes need to be continuously modified (Nilakant and Rao, 1994). The timing of launching such campaigns is an important factor. It must neither be so slow that employees

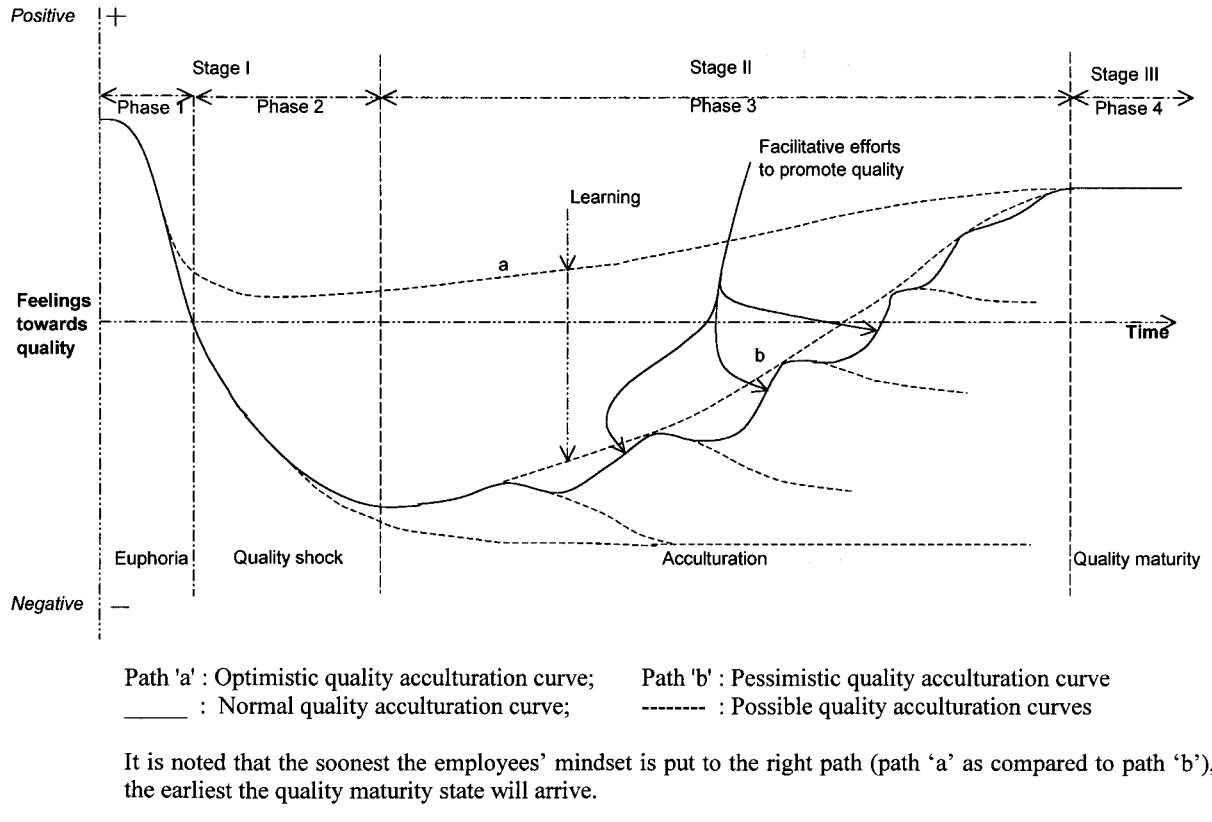

Figure 5 Quality acculturation curve

think the quality philosophy or focus is dead, nor be so aggressive that employees feel it impedes their work environment.

Phase 4 represents that the stage of 'quality maturity' has reached. Employees are totally adapted to the quality environment and are all committed to quality. At this point, quality thinking is widespread across the company, and the quality system is fully integrated into the organization's culture and system. It is noted that the sooner the employees' mind is set on the right path (path 'a' as compared with path 'b'), the sooner quality maturity will be reached.

QA scheme

'Site supervision' is important and ranks third, with a relative importance index of 0.822. In fact, one requirement of the ISO 9000 QA scheme is a proper documentation procedure in site supervision to enhance the traceability of defects. However, as reported by Tam and Tong (1996), the procedure may be adopted easily by adaptable staff, but it is very difficult to educate staff who have established their own working procedures. These inflexible staff may bypass the checking procedures by just signing the forms without doing the actual checking. This reflects the importance of the QA scheme in quality improvement if the scheme is properly followed and quality is genuinely pursued. However, to accomplish that, an attitudinal and cultural change in people's mindsets is required.

Market

'The adequacy of project duration' is attributed to the market structure of the industry. Clients always want to complete a project as soon as possible in the highly speculative market, and the public housing client would tend to adopt the duration norm of private projects. Further, the construction duration has been compressed to cope with the unprecedented challenge of the urgent demand for public housing. The structural frame cycle duration has been shortened from 8 days to 6 days and further to 4 days. The shortened duration results in inadequate inspection time, according to interviews with site management. As a result, the quality of construction work suffers.

'Labour turnover' reflects the high labour mobility in construction sites. Subcontract labour does not have a long term relationship with the main contractor and thus lacks loyalty. Both parties act in their own self-interest and with guile. This may hamper construction quality. This issue is concerned with the market structure under which contractors are reluctant to maintain a pool of in-house direct labour.

Project

'Project complexity' is ranked sixth, with a relative importance index of 0.744. This is the only project-specific factor. However, in public housing construction, the designs are standardized and hence the effect of project complexity is minimal.

Management

'Overtime work' is ranked eighth, with a relative importance index of 0.711. Working overtime is very common in the industry, caused first by the short project durations, and second by poor planning and management. Working late in the evenings and at night impairs visibility. This, coupled with worker fatigue, reduces both efficiency and performance. This is classified as a management problem.

'Proportion of certified skill labour and training provided' is ranked ninth with a relative importance index of 0.689. Burati *et al.* (1992) pointed out that it is universal for construction workers to switch from one company to another. The transient nature of the construction force is different from the relatively stable manufacturing work force and makes it more difficult to train workers, particularly craft labour (Arditi and Gunaydin, 1998). On the other hand, the importance of training is recognized by every quality expert (Iami, 1986; Smith, 1988), and is highlighted in the ISO 9000 Standard (Doyle, 1994). However, the practice of buying at the lowest price is detrimental to training labour (Mortiboys, 1991). Therefore the Housing Authority and Construction Industry Training Authority in Hong Kong have set up extensive programmes in training, testing and certifying skilled workers. Recently the Housing Authority mandated the employment of a certain percentage of certified tradesmen in public housing construction contracts. This factor is both a market and a management problem.

Structure

'Subcontract system' is ranked tenth, with a relative importance index of 0.689. The characteristics of a multi-layered structure of sub-subcontractors are that responsibility is diffused and quality diminished. It is difficult, if not impossible, to identify who does what and who is responsible for quality (Mortiboys, 1991). The respondents graded 'competitive tendering approach' eleventh in the order of priority, with of a relative importance index of 0.667. The effect of 'the lowest bidding wins' policy on quality has been recognised (Low and Tan, 1996; Kam and Tang, 1998). This encourages contractors to risk bidding below normal profit margins with the prospect of recovering costs by cutting quality later.

The respondents ranked 'cooperation of project parities' twelfth, with a relative importance index of 0.644. In the construction processes, the extent of cooperation between parties was found to be important (Arditi and Gunaydin, 1998; Ferguson and Clayton, 1988). Indeed, the high quality of construction is dependent not only on the designer for quality design and subcontractors for timely and good quality work, but also on material suppliers for timely delivery of materials specified in the contract. In particular, the competitive tendering policy is liable to result in conflicts of interest between contractors and clients and can lead to confrontational and win–loss relationships.

Recommendations to achieve sustainable quality improvement

Given the fact that it is difficult to change the market and structure of the industry, modifications are required to 1, cultural change and 2, motivations to use PASS.

From our study it is found that culture related factors are the most important ones affecting construction quality. The lack of a cultural foundation in the current ISO 9000 quality management system may account for the current rejection of quality management initiatives in the local industry. This view has been supported by some Hong Kong researchers (Chan, 1997; Chu, 1997; Lo and Cheng, 1997). In fact, the ISO 9000 quality management system does not address the psychological or behavioural aspects involved when people of different cultures attempt to use it. If behaviour is not consistent with systems, either the behaviour must change or the system will fail (Napier, 1997). Driving our behaviour is our attitude, which depends on the values we hold (Williams, 1994). Cultural changes, as we said, are a long journey. Along the journey, some facilitative efforts are needed to reinforce and track the changes. Some recognition by the government and clients of the quality effort needs to be addressed. Campaigns and promotion need to be continuously implemented to reinforce quality concepts in people's minds.

At the same time, PASS has some shortfalls that need to be addressed. Currently, eligibility for tendering future public housing contracts based on past quality records (PASS scores) cannot provide enough incentive for contractors to improve construction quality. As such, contractors have little motivation to strive for the target PASS scores. That causes the PASS score to remain stagnant at its current position. In Singapore, a tendering advantage of up to 5% in public sector building tenders is given to contractors who consistently achieve good quality work as reflected through the high 'Conquas' scores (Lam *et al.*, 1994). Such additional monetary incentives may be more widely received by the industry than simply providing tendering opportunities for those contractors with high PASS scores.

Conclusions

Quality management in a construction setting is more difficult due to industry-specific reasons such as the market and structure of the industry. In Hong Kong, although the Housing Authority of Hong Kong has implemented a series of quality improvement tools, few local ISO 9000 certified contractors undertaking public housing construction can improve their quality performance. The PASS scores, the objective quality measuring yardstick, remain stagnant, which shows that continuous improvement in construction quality has not been achieved. Our structured survey has unveiled a wide spectrum of factors affecting construction quality, in which the two top-ranked factors are concerned with culture. Therefore, ultimate success in quality can be achieved only when the quality system is fully integrated into one's organizational and industrial culture. This will demand constant quality reinforcement and greater facilitative efforts along the journey to 'quality maturity'. Meanwhile, PASS needs to be modified to provide proper motivation along the 'quality journey'. One of the recommendations is to provide a monetary incentive to contractors who can achieve good quality performance. With all the recommendations in place, public housing construction may attain the ultimate quality target: continuous improvement in quality.

Acknowledgement

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Appendix

Target quality score (TQS) of a month is defined from the 'monthly output score league'. A '*provisional*' TQS is worked out as the output score of the upper quartile position of the 'monthly output score league'. TQS is a non-decreasing benchmark figure in PASS. The '*provisional*' TQS is compared with the TQS of the previous month. The higher value of the two figures is taken as the current running TQS. The monthly TQS may be reset from time to time.

Monthly Average Output Score (Monthly Av.) is the average output scores for all new works projects of the month.

Lower Score Threshold (LST) of a month is defined from the 'monthly output score league'. The LST is the output score of the lower quartile position of the 'monthly output score league', and it floats from month to month.