QUALITY MANAGEMENT SYSTEMS FOR PUBLIC HOUSING CONSTRUCTION IN HONG KONG

C. M. TAM

Department of Building and Construction, City University of Hong Kong
83 Tat Chee Avenue, Kowloon Tong, Hong Kong

ARTHUR W. T. LEUNG

Division of Building Science & Technology, City University of Hong Kong
83 Tat Chee Avenue, Kowloon Tong, Hong Kong

ABSTRACT

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 prefabrication technology, are directed towards achievement of a desired quality standard. However, the PASS analysis has revealed that the general level of quality has not significantly improved and continuous improvement in construction quality has not been realized as expected over a specific time period. Quality appears far better on paper than does the actual work on site. This shows 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

Unlike other industries, the construction industry is characterized by activities, which are discontinuous, dispersed, diverse and distinct; i.e. the four “D”s as described by Tay (1994). The industry is further complicated by its high fragmentation of structure. The project team members, including designers, engineers, government officials, the client, users, the main contractor, subcontractors, sub-subcontractors, etc., may belong to a unique separate entity; each fortifies their own benefits and territories. Quality management in such a construction setting is therefore very difficult to implement and a sustainable improvement in quality is difficult to achieve (Low and Tan, 1996). Acknowledging these difficulties, the Hong Kong Housing Authority (HKHA) has implemented a series of quality enhancement initiatives including the mandatory ISO 9000-quality assurance certification scheme, use of mechanization in construction, standardization of designs and use of prefabrication technology. Claiming to be a pioneer in this respect, HKHA suggested the slogan of “quality starts with housing” (Chan, 1993). Matching words to action, HKHA established the Performance Assessment Scoring System (PASS) in 1990 as a means to facilitate the ultimate target of “continuous quality improvement” in managing the list of building contractors (HKHA, 1994). ISO 9000 certification exercise has been made mandatory in 1992, believing that quality needs to be built into the process and a self-initiated quality management system is more effective than keeping contractors under client’s surveillance.
However, it seems that actual achievements as a result of implementing these quality management systems, such as PASS, ISO 9000 quality assurance system, quality awareness campaign, etc., are below original expectations (Kam and Tang, 1998). This paper aims to evaluate these systems and explore the possible reasons for the failure. Finally, it proposes some changes to the system for enhancing its effectiveness.

PASS

In 1990, the HKHA introduced PASS. The system became effective in July 1991 as a measure to manage building contractors contracting for public housing construction. The system is designed to reward contractors who perform to the required standard with higher tendering opportunities by granting more tendering chances to contractors whose average PASS score falls into the upper quartile of the overall PASS scores (Kumaraswamy, 1996).

PASS has been developed to measure performance output directly against defined standards and to provide a fair means of 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 3 types of measurement; namely, “output”, “input”, and “maintenance” assessments. The input assessment mainly deals with the management capability, organization and communication issues. The output assessment is to assess 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 while the weighting of the “output” and “input” assessments is 75% and 25% respectively. “Maintenance” assessment is used as a supplementary tool for decisions to penalize 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 are 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 are 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. 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 “hard-line” 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 any deviation of work from the specification (Housing Department, 1996).
ANALYSIS OF PASS

In this study, data on PASS was obtained from the Hong Kong Housing Authority. Individual monthly PASS output scores of 150 public housing projects, which were undertaken by 41 contractors from July 1994 to June 1998, were obtained.

Monthly variation of PASS scores

The monthly average PASS output scores, the target quality scores (TQS), and the lower score threshold (LST) (see definitions in Appendix) from July 1994 to June 1998 are shown in Figure 1.

![Figure 1. Monthly average PASS scores](image)

From Figure 1, it is indicated that there is a marked decrease of monthly average PASS scores between January and June 1995 due to the fact that the Housing Department decided to tighten the rules when they found that the system could not provide sufficient discrimination in PASS score assignment. The gap between the monthly average scores and the TQS has been enlarged (between 10.70-13.70) since July 1995. Moreover, no rising trend for PASS scores can be found, which reveals that the expectations of promoting continuous quality improvement have not been achieved.

Relationship between market share and performance

From July 1994 to June 1998, the number of contractors conducting public housing projects is shown in Table I.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994-95(^a)</td>
<td>21 (100)(^b)</td>
</tr>
<tr>
<td>1995-96</td>
<td>25 (119)</td>
</tr>
<tr>
<td>1996-97</td>
<td>29 (138)</td>
</tr>
<tr>
<td>1997-98</td>
<td>34 (162)</td>
</tr>
</tbody>
</table>

**Notes:** \(^a\) From July to June; \(^b\) The figures in brackets indicate the percentage change of number of contractors

Table I indicates that the number of contractors conducting public housing projects has increased. During the period of 1994 to 1998, contractors of various sizes in terms of the number of public housing projects constructed are categorized in Table II.
Table II. Contractor sizes based on projects conducted

<table>
<thead>
<tr>
<th>Size of contractor (Classified according to turnover)</th>
<th>Projects conducted by contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>20+</td>
</tr>
<tr>
<td>Medium</td>
<td>10-20</td>
</tr>
<tr>
<td>Small</td>
<td>1-9</td>
</tr>
</tbody>
</table>

Although there were 41 contractors taking part in public housing construction from 1994-1998, the number of projects handled by each contractor varied distinctly. Table III lists the contractors and the number of projects undertaken.

Table III. Number of contractors and the undertaken projects

<table>
<thead>
<tr>
<th>No. of Contractors</th>
<th>Proportion of all contractors (%)</th>
<th>Projects conducted by a contractor</th>
<th>Proportion of total projects (%)</th>
<th>Size of Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (1)</td>
<td>2.4 (2.4)</td>
<td>23 (23)</td>
<td>15.3 (15.3)</td>
<td>Large</td>
</tr>
<tr>
<td>1 (2)</td>
<td>2.4 (4.8)</td>
<td>21 (44)</td>
<td>14.0 (29.3)</td>
<td>Large</td>
</tr>
<tr>
<td>1 (3)</td>
<td>2.4 (7.2)</td>
<td>10 (54)</td>
<td>6.7 (36.0)</td>
<td>Medium</td>
</tr>
<tr>
<td>3 (6)</td>
<td>7.3 (14.5)</td>
<td>8 (78)</td>
<td>5.2 (51.6)</td>
<td>Small</td>
</tr>
<tr>
<td>2 (8)</td>
<td>4.9 (19.4)</td>
<td>6 (90)</td>
<td>4.0 (59.6)</td>
<td>Small</td>
</tr>
<tr>
<td>2 (10)</td>
<td>4.9 (24.3)</td>
<td>4 (98)</td>
<td>2.7 (65.0)</td>
<td>Small</td>
</tr>
<tr>
<td>7 (17)</td>
<td>17.1 (41.4)</td>
<td>3 (119)</td>
<td>2.0 (79.0)</td>
<td>Small</td>
</tr>
<tr>
<td>7 (24)</td>
<td>17.1 (58.5)</td>
<td>2 (133)</td>
<td>1.3 (88.1)</td>
<td>Small</td>
</tr>
<tr>
<td>17 (41)</td>
<td>41.5 (100)</td>
<td>1 (150)</td>
<td>0.7 (100)</td>
<td>Small</td>
</tr>
</tbody>
</table>

Notes: Figures in brackets indicate the cumulative sum.

Table III reveals that only 4.8 percent and 2.4 percent are large and medium sized contractors respectively, and 92.8 percent are small contractors. At the same time, large-sized contractors amounted for almost 30 percent of projects.

Comparison between contractors

Comparing the performance of the 41 contractors, the average PASS scores for each contractor were calculated and shown in Figure 3.
Figure 3 reveals that the performance of contractors varies significantly (with the highest at 93 and the lowest at 63). The distribution of the average PASS scores of contractors from the Target Quality Score (TQS) established by the Housing Authority is indicated in Table IV.

<table>
<thead>
<tr>
<th>Range (TQS =93.70 as from June 1994 onward)</th>
<th>Number of contractors</th>
<th>Characteristics of contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 5% of TQS (Score &gt; 89.02)</td>
<td>1 (2.4%)b</td>
<td>1 S^a</td>
</tr>
<tr>
<td>6% - 10% of TQS (89.02&gt;Score&gt;84.33)</td>
<td>5 (14.6%)</td>
<td>1 L &amp; 4 S</td>
</tr>
<tr>
<td>11% - 15% of TQS (84.33&gt;Score&gt;79.65)</td>
<td>15 (51.2%)</td>
<td>1 L, 1 M &amp; 13 S</td>
</tr>
<tr>
<td>16% - 20% of TQS (79.65&gt;Score&gt;74.96)</td>
<td>14 (85.3%)</td>
<td>14 S</td>
</tr>
<tr>
<td>21% - 25% of TQS (74.96&gt;Score&gt;70.28)</td>
<td>3 (92.7%)</td>
<td>3 S</td>
</tr>
<tr>
<td>26% - 30% of TQS (70.28&gt;Score&gt;65.59)</td>
<td>2 (97.6%)</td>
<td>2 S</td>
</tr>
<tr>
<td>Beyond 30% of TQS (65.59&gt;Score)</td>
<td>1 (100%)</td>
<td>1 S</td>
</tr>
</tbody>
</table>

Notes:  
^a This contractor has undertaken one project and only one score has been recorded up to the end June 1998 and so the score is not representative.  
^b The cumulative percentage

L = Large-sized; M = Medium-sized; S = Small-sized

Table IV indicates that only a few contractors are able to achieve the target quality score (refer to the Appendix for the definition of TQS which is set to be the output score of the upper quartile position of the “Monthly Output Score League” and is a non-decreasing benchmark figure). Only about 15% of contractors that include one large and five small-sized contractors are able to perform up to within 10% range of TQS. About half contractors’ average PASS scores are beyond 15% range of TQS.

Concluding from Figure 3, Table III and IV, it can be noted that the two large and one medium contractors undertaking 36% of all work have PASS scores within 15% of TQS. This suggests that there is perhaps a relationship between the market share of a contractor and his average PASS score. An interesting fact is that contractors with bigger market share and turnover have higher average PASS scores. The first few contractors who scored relatively high average PASS scores have taken up a large portion of the market share. All those contractors with a low average PASS score were typically the small contractors.

Discussion and Suggestion

The above analyses indicate that the use of PASS scores by the Hong Kong Housing Authority aiming at the continuous quality improvement objective of TQM in public housing construction still falls short of the target. The PASS scores, being an objective quality measuring yardstick, remained stagnant over the period July 94 – June 98. Only a few contractors can achieve the desirable quality levels and the majority of contractors are still some distance away from them. This may suggest that efforts from both sides of the contract need to be synchronized; that is, construction firms need to install their own quality management programs. Unfortunately, the current competitive tendering approach that advocates bidding on price only cannot encourage this. Moves towards integrated procurement systems need to be considered that can help dissolve the fortification of various parties in a construction project and change the quality culture of the industry. Further, quality needs to be rewarded in one way or the other. The incentive of a higher tendering opportunity is definitely not adequate and cannot provide a strong motivator.
ISO 9000 QUALITY ASSURANCE CERTIFICATION SCHEME

In April 1990, the Hong Kong Housing Authority mandated that main contractors take ISO 9000 certification before 31 March 1993. Contractors have, then, expended large amounts of money and resources in setting up and running necessary management system. A survey conducted by the authors shows that the setting up cost for individual organizations ranged from HK$1 - 3 million with a mean running cost of around 0.2% of contract values.

However, the findings of the survey cannot prove statistically that there are any significant changes in the quality of the final products after the implementation of the ISO 9000 quality assurance certification exercise. The study indicates that de-motivation, communication breakdowns and the structure of the industry have caused the failure. People have started off with an attitude that the scheme was aimed to fulfill the contractual requirements rather than originating from an awareness and concern for quality. The survey shows that the certification exercise was used mainly for complying with contractual requirements rather than arising from any real concern for quality issues among contractors. Such violates the original assumption of a self-initiated and self-improving quality management system. Thus, the system generates pressure from top to lower levels of management demanding fulfillment of the certification exercise by way of meaningless paperwork.

Reasons for the breakdowns are summarised as follows:

1. Control of Subcontractors
   The labour supply structure in the industry in Hong Kong is characterised by the presence of multi-layers of subcontractors. It is quite impossible to impose the requirements of ISO 9002 on these subcontractors as few of them have any management system or quality system; some are not even registered as a company.

   The QA managers must assume 100% management control of these subcontractors. However, as the skill of labour is not tested or proven, and labour mobility is high, the result is that an effective communication system is very difficult to achieve.

2. Control of Suppliers
   Most materials are purchased through agents who name themselves 'suppliers' in the industry. These agents normally deal with many sub-agents who order goods from manufacturers all over the world such as the PRC, Philippines, etc. where no quality system is in existence and the influence of the main contractor is almost non-existent.

   Given the above circumstances, it is not possible for contractors to effectively communicate the QA system to subcontractors.

3. Inspecting, Measuring, and Testing Equipment
   Because of the vast workforce involved and the large number of trades on a job site, calibration, identification and traceability of all the measuring and testing equipment are very difficult to manage.

   For example, it would be impossible to control measuring tapes used if everybody brought a personal tape. Additionally, most small contractors usually hire plant rather than owning it, and calibration and control of a third party's plant are very difficult.

4. Changes in Design and Drawings
   Changes in design and drawings are very common in the industry when a project is under construction. This results in many variation orders and additional works hampering the documentation and communication system.
5. Site Management and Control
ISO 9000 involves setting up a proper documentation system resulting in a great deal of paper work and control forms. It is, perhaps easier for adaptable staff but very difficult to educate staff who have established working procedures. These inflexible staff may bypass the checking procedures by just signing the forms without doing the actual checking.

For small contractors who have limited additional resources, the lack of additional staff to support the QA system may jeopardize it.

6. Multi-quality system
In cases where most nominated subcontractors and suppliers have their own quality systems and different procedures, it may be difficult to reach a compromise on the system used. Thus the amount of paperwork may be doubled or even tripled.

7. Considerable Amount of Paperwork
In order to ensure high quality and compliance with specifications, checking, a significant proportion of every process of work (say 10%), is necessary. Considering the large number of different trades working simultaneously in hundreds of different locations on a large site, there are thousands of check forms to be handled daily and each form may need to be signed and verified by sometimes three or more persons. The survey reveals that this considerable amount of paperwork often annoys site management staff, who then may cut corners in handling the paperwork.

8. Acceptance Criteria
Different people may have different acceptance criteria, especially as regards qualitative works such as finishing trades. Subcontractors themselves may accept work which is not acceptable to the main contractors. This always turns the quality improvement goals into disputes and confrontation.

9. Document Control
The quality system stipulates a document control procedure that all obsolete documents must be promptly removed from all points of issue. That is extremely difficult in the industry because:
- the existence of the multi-layers of subcontractors makes the chain of issue very long and inaccessible.
- many drawings may be affected by a single change.
- it is still very common for architects and engineers to give verbal instructions, sometimes without written confirmation.

10. Material control
The handling, storage, packaging and delivery methods stipulated in the quality system may sometimes be very difficult to follow due to site congestion and restricted site conditions such as those encountered in most private jobs in Hong Kong. The ensuring non-compliance makes the system breaking down.

11. Contract Review
Failure of this process is highlighted by the following sarcastic question raised by one interviewee: "Would any one believe that a contractor would submit his non-conformance report to the Architect?" This response typifies a general attitude.

12. Client's Control
One of the major principles of QA is that all parties to the building process must play an active role and their respective contributions may be integrated (CIOB 1990). However, most interviewees complained that with current contractual agreements, clients and architects still retain the ultimate authority in approving subcontractors, materials used, and the construction process. Hence contractors need to follow instructions in carrying out their works. Thus there is
little room for contractors to contribute innovative, cost saving and quality enhancing suggestions.

13. Full Top Management Support
In order to secure the accreditation and window-dress the quality manual, the quality policy always stresses the need for full support of the quality system from top management. However, 50% of the interviewees mentioned that profitability is more important to them; sometimes sacrificing quality rather than following the quality management system. Most interviewees admitted that the QA system is designed to meet the contractual requirements of the Housing Authority rather than trying to improve the company's internal efficiency and external image.

Discussion and Suggestion

At present, the QA system is mandatory that generates a number of shortfalls. Contractors are not genuinely committed to quality but just try to comply with the contract requirements. The excessive paper works de-motivate site personnel to follow the scheme. The following provides some recommendations in improving the use of QA for the industry.

- Clients need to realise that QA is a way to quality but not the end.
- The ISO 9000 certification exercise should not form a hurdle for inclusion on tender lists. Instead, contractors should be encouraged to adopt the system voluntarily. They should be commended and rewarded by their effort on quality enhancement initiatives, the process and products, and not by the process alone.
- Quality concern should be aroused by educating the public and contractors. Genuine commitment from contractors in quality management is preferred to enforcing the scheme by administrative power.
- The multiple tiers of labour-only subcontracting system need to be changed. Contractors or large subcontractors should be encouraged to hire monthly paid employees.
- The levels of subletting should be restricted to a certain extent to avoid cow-boy type of subcontractors.
- The present confrontational relationship between various project parties must be changed by adopting an integrated approach in project procurement.

CONCLUSION

When the quality management systems have been implemented for some time and still the anticipated results cannot be materialized, there should be a review to the systems. PASS and ISO 9000 are the major quality management arms of the Hong Kong Housing Authority. However, after years of implementation, there are no obvious improvements. The systems need to be audited. This paper has provided some clue in enhancing the system by putting forward some recommendations.

The ultimate objective of any quality management systems is to inculcate a quality culture in the industry of which the industry is lacking. Other structural changes (such as the procurement systems, reward for quality systems, the labour only subcontracting system, etc.) need to be synchronized in order to expedite the change.

REFERENCES


Housing Department (1996), *PASS Manual*, Hong Kong.


**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.