DEVELOPMENT OF CONSTRUCTION QUALITY MANAGEMENT AND THE RELATED SYSTEMS IN HONG KONG

RAYMOND T. AOIEONG
Department of Civil & Environmental Engineering, University of Macau, Macau, China

S. L. TANG
Civil and Structural Engineering Department, The Hong Kong Polytechnic University, Hunghom, Kowloon, Hong Kong, China. cesltang@polyu.edu.hk

ABSTRACT

With an ever-blooming population, there have always been demands for public housing in Hong Kong. To meet with the huge demand for public housing, construction quality has often been sacrificed at the expense of quantity in the 1970s and 1980s. The maintenance problem of these poor quality buildings and the higher expectation on housing quality from the public, have prompted the Hong Kong Housing Authority (HKHA) to focus on its construction quality. To achieve the goal of providing quality housing, a good quality management system is crucial. A number of construction quality tools, like Quality Assurance Systems, Quality Indicators and the related systems, have been developed and implemented by the HKHA since the early 90’s. This paper describes the implementation of these quality tools and their effectiveness in monitoring the performance of construction organizations in Hong Kong. Two of the trends in producing high quality building, partnering and off-site production are described.

Keywords: Construction, housing, quality, management, quality management systems, QMS, Hong Kong.
INTRODUCTION

As a fast developing society with a vibrant economy and a blooming population, initial expectations of the construction clients and end-users in Hong Kong were quantity rather than quality. Nevertheless, economic prosperity and problems resulting from the poor quality of earlier buildings shifted the society’s focus towards quality. This paper presents the various measures taken to manage the quality of construction work to meet the rising quality expectations. Because of the colossal public housing construction challenge and the commitment to satisfy rising aspirations for quality, the Hong Kong Housing Authority (HKHA) found itself pioneering construction quality management in this territory.

In the post World War II period, Hong Kong experienced a great influx of immigrants. The result was that many lived as squatters in makeshift housing that neither had consideration for safety nor hygiene. On the Christmas Eve of 1953, a disastrous fire spread through the Shek Kip Mei squatter area leaving some 53,000 people homeless. This event initiated the Hong Kong Government’s extensive public housing policy. Early in 1954, Resettlement Department (RD) was established to relocate and provide shelter to the fire victims.

It was a mammoth emergency task where the objective was to quickly provide safe (fire-proof and typhoon-proof) and relatively hygienic shelters. By the end of 1954, eight permanent resettlement two-storey blocks were constructed where each block could house 20,000 persons, providing 5 square meters per person. Buildability was a concern of those who were engaged in this rapid construction programme, thus precast concrete components were used, although, the objective of applying the technique was to gain speed rather than quality.

Not only were the victims of the Shek Kip Mei fire, there were many others in dire need of reasonable housing. The Housing Department (HD) was established in 1954, with the objective of providing self-contained housing for low to middle-income households. Although HD built better standard housing than RD did, the overwhelming demand for high volume was met at the expense of quality. In 10 years time (from 1954 to 1964), 240 resettlement blocks were constructed housing some 500,000 persons.

Growth of concern for quality

Until the early 1970s, the Governmental intervention in housing was fragmented and ad hoc. In October 1972, a Ten-year Housing Development Plan was announced to make planned developments that would house 1.8 million people over the next 10 years in permanent self contained homes that provided 3.3 square meters per person, good amenities, decent environment and neighbourhood ancillary facilities such as schools, clinics, restaurants, market stalls, and so on. To support and thrust this programme, on 1st April 1973, a new HKHA (Hong Kong Housing Authority) was formed by amalgamating the RD and the old HD.

As the public housing stock was growing since 1954 through the 1960s, maintenance cost kept on increasing, particularly due to poor workmanship, for example, honeycombing,
bulging, misalignment, etc. arising from traditional small size timber formwork and site mixed concrete. Hence, there was growing concern for quality improvement through the 1970s and the 1980s, prompting the use of large panel formwork, standardisation of plans to enable the use of such formwork, use of mechanisation such as tower cranes to lift large panel formwork, and ready mixed concrete and concrete pumps to effectively concrete the large moulds.

The real awakening, however, came in 1986 with HKHA (or HA for short) realising that 26 public housing blocks that have been in use for some 20 years, housing some 70,000 people, have deteriorated beyond the point at which repair is economically worthwhile. Meanwhile, to accommodate the rapidly growing population and to reduce the long waiting lists for public housing, HA formulated in 1987, the Long Term Housing Strategy with the expectations of housing some 1,085,000 persons by the year 2001. This sheer challenge of delivering both quantity and quality, made HA (as evident from Table 1) pioneer construction quality management in Hong Kong. Table 1 summarizes the Hong Kong Government's quality initiatives in the last two decades (modified from Chan et al., 2002).

**Implementation of Quality Assurance Systems**

The first Quality Assurance Standard, BS 5750 was published in 1979 and the International Organisation for Standardisation used it as the basis for ISO series of standards published in 1987. Over the decade that had passed since the publishing of BS 5750, manufacturing and other industry sectors had begun to implement these management tools, while there was no apparent interest within the Hong Kong construction industry.

Understanding the potential benefit of quality assurance systems and to guarantee quality at source, HA encouraged the two major local precast prestressed spun concrete pile manufacturers to develop quality schemes for their products in 1987 (McNicholl et al., 1989). Under the quality surveillance to the manufacturing of concrete piles, it was observed that the schemes provided a high measure of quality assurance for an important element in the building process. Since 1989, as evident from Table 3.1, HA has been stepping up measures to improve the quality standards of public housing, such as: establishing a ‘Quality Assurance Committee’ to promote improved standards in public housing construction, planning to setup its own approved list of building contractors and jointly with the Hong Kong Construction Association commissioning a consultancy to advise the construction industry on how to establish an acceptable quality assurance system.

In 1990, HA identified the need of a formal set of design and construction procedures for their professionals. HK Industry Department, incidentally, was having a quality drive and encouraged HA to go a step further to require ISO 9000 certification. It was decided that the Works Group of the HA would develop a quality management system complying with ISO 9001 by mid 1993.
Table 1. Calendar of Key Events

<table>
<thead>
<tr>
<th>Key Dates</th>
<th>Key Events</th>
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<tr>
<td>1986</td>
<td>26 public housing blocks that have been in use for some 20 years, housing some 70,000 people, had to be redeveloped because of poor construction quality.</td>
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<td>HA stepped up measures to improve quality by establishing a ‘Quality Assurance Committee’, commissioning a consultancy to advise the industry on establishing acceptable quality assurance systems and planning its own lists of approved building contractors.</td>
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<td>Early 1990</td>
<td>HA identified the need of a formal set of design and construction procedures for their professionals. HK Industry Department was having a quality drive and encouraged HA to go a step further to require ISO 9000 certification.</td>
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<tr>
<td>Feb 1990</td>
<td>HA began developing the Performance Assessment Scoring System (PASS) to measure contractor performance against defined standards, aiming to provide better tendering opportunities to contractors that score higher in the assessments.</td>
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<tr>
<td>Apr 1990</td>
<td>HA established its own lists of approved building contractors for new works and maintenance works, and required all of them to be certified to ISO 9000 by 31 March 1993.</td>
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<tr>
<td>Jan 1991</td>
<td>HA implemented the Performance Assessment Scoring System (PASS).</td>
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<tr>
<td>Early 1991</td>
<td>HA implemented the Maintenance Assessment Scoring System (MASS).</td>
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<tr>
<td>Aug 1992</td>
<td>HA required concrete suppliers to be certified to ISO 9000.</td>
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<tr>
<td>Mar 1993</td>
<td>HA required all building contractors to be certified to ISO 9000.</td>
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<tr>
<td>Aug 1993</td>
<td>The Housing Department’s Construction Branch was committed to be certified to ISO 9000.</td>
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<tr>
<td>1994</td>
<td>HA implemented the 1994 version of Performance Assessment Scoring System (PASS).</td>
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<tr>
<td>Oct 1994</td>
<td>HA required electrical, lift and escalator contractors to be certified to ISO 9000.</td>
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<tr>
<td>Oct 1995</td>
<td>HA required fire services and water pumps contractors to be certified to ISO 9000.</td>
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<tr>
<td>Apr 1996</td>
<td>WB required all engineering, architectural and associated consultants to be certified to ISO 9000.</td>
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<tr>
<td>Oct 1996</td>
<td>WB required all List I &amp; II, Group C contractors to be certified to ISO 9000.</td>
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<tr>
<td>April 1997</td>
<td>HA implemented the 1997 version of Performance Assessment Scoring System (PASS).</td>
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<td>1997</td>
<td>HA introduced ‘Laboratory Assessment Scoring System’ for laboratories and the ‘Building Services Performance Assessment Scoring System’ for building services contractors.</td>
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<td>Jan 1998</td>
<td>WB required all specialist contractors for land piling – Group II to obtain ISO 9000 certification.</td>
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<td>Jan 1998</td>
<td>ISO 9001 certification requirement was extended to piling contractors.</td>
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<tr>
<td>Mar 1998</td>
<td>HA formed the PASS Control Unit (PCU) to carryout an in-depth review of PASS.</td>
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<tr>
<td>Jul 1998</td>
<td>ISO 9001 certification requirement was extended to demolition contractors.</td>
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<td>1999</td>
<td>Preferential Tender Award System was introduced by HA for building contacts.</td>
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<td>2000</td>
<td>Implementing the plan “Quality Housing: Partnering for Change”.</td>
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<tr>
<td>Jan 2001</td>
<td>Construction Industry Review Committee (CIRC) report recommended ‘Partnering’ as a solution to the HK construction industry’s problems.</td>
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HA – HK Housing Authority      WB – HK Government Works Bureau
In April 1990, HA established its own list of approved building contractors for new works and maintenance works. The biggest ever impact on quality concerns of the construction industry was delivered when HA required that all contractors on the list should be certified to ISO 9000 by 31st March 1993. The contractors who were interested in the growing volume of work of HA projects had no other option but to comply.

Following the announcement of the quality policy statement, the Hong Kong Government Secretary for Works issued the formal quality guidelines in March 1996, requiring consultants and contractors for governmental construction projects to obtain ISO 9000 certification by April 1996 and October 1996 respectively (see Table 1).

In December 2000, a new edition of ISO 9000 was released. The Hong Kong Government required all construction organizations in Hong Kong to obtain re-certification to ISO 9000:2000 version by December 2003 in order that they could submit tenders for public jobs such that they could keep up with the latest trend of quality management development.

The Hong Kong Government is the biggest construction client in Hong Kong and the extensive public housing programme makes HA one of the largest property developers in the world. Hence, it is difficult for any major construction company in Hong Kong to ignore the huge market potential of the public sector projects. The requirement for ISO 9000 certification by the public sector clients forced all construction consultants and contractors to implement quality assurance systems conforming to ISO 9000, thus successfully increasing the awareness and the concern for quality. Today, private sector projects also implement ISO 9000 quality assurance systems.

**Development of Quality Indicators**

Although certification to ISO 9000 could give assurance of quality capability and compliance, it fell short of providing a means of comparing the performances of different contractors. In this respect, a construction quality measurement system, the Construction Quality Assessment System (CONQUAS), was launched in the Singapore construction industry in 1989. Inspired by this system, and using it as a basis, HA proceeded in 1990 to develop a quality measurement system, the Performance Assessment Scoring System (PASS), to be applied in Hong Kong public housing projects. CONQUAS and PASS are Quality Indicators, which serve as the tools for measurement or assessment of the quality of finished construction products. (Readers should note that a quality indicator is different from a quality audit. The former is for measuring the standard of finished products and the latter for measuring the effectiveness a quality management system). PASS attempts to systematically and objectively measure new works construction contractors’ performance against predefined standards, thus enabling a fair comparison between individual contractors. At the same time another quality measurement system, the Maintenance Assessment Scoring System (MASS), was developed to assess the quality performance of maintenance contractors. These efforts demonstrated the commitment of HA to obtain from the contractors more than just compliance with ISO 9000.

Contractors performing better were rewarded under the Preferential Tendering Eligibility Procedures, by allowing more tendering opportunities than those with poor performance.
Later in 1999, the incentive was increased by adopting the Preferential Tender Award System where the better performing contractors would get preference in the award of tenders.

Since January 1991, all building construction sites were subject to a monthly PASS inspection. At site locations selected based on random sampling, assessments of compliance with specifications were made in the presence of the contractors. The following year, 1992, eligibility of contractors to tender for new works building contracts was selected (under the preferential tendering eligibility procedures) based on their performance on existing contracts as measured by PASS. In 1993 it was observed that, since the implementation of PASS, the benchmark Target Quality Score for contractors moved up to 92%, indicating that contractors had achieved better quality.

Two more assessment systems, the Laboratory Assessment Scoring System and the Building Services Performance Assessment Scoring System (BSPASS), were developed by 1997 to assess the performance and capabilities of laboratory services and building services contractors respectively, together with a reward system for good performance. At present, HA has launched Building Services Maintenance Assessment Scoring System (BSMASS) also.

**Development of Accreditation Services**

As ISO 9000 quality assurance systems were becoming popular in Hong Kong, there appeared a need for facilitating accreditation services. An accreditation organization (e.g. HKQAA, see below) is one who awards ISO 9000 certificate to a company after quality auditing, a management process to confirm and evaluate the effectiveness of a quality management system (QMS), as mentioned in the previous section. This section briefly explains the developments in this respect.

**The Hong Kong Quality Assurance Agency (HKQAA)**

The Hong Kong Quality Assurance Agency (HKQAA) was established in 1989 and subsidized by the Hong Kong Government, as an independent non-profit organisation, to undertake third party certification under a registration scheme based on ISO 9000 standards. Its scope of operation covers companies carrying on business in the manufacturing, construction and service sectors. Besides HKQAA, there are as many as 11 other overseas organisations providing ISO 9000 certification services in Hong Kong.

**Hong Kong Laboratory Accreditation Scheme (HOKLAS)**

HOKLAS has been operated by the Hong Kong Industry Department since 1985, with an aim to improve the standard of testing and management of laboratories by providing official recognition for accredited laboratories. The scheme also benefits local traders directly from the mutual recognition agreements signed with accreditation bodies of Hong Kong's major trading partners. The laboratories provide three broad services of quality assurance testing, product inspection, quality consultancy and calibration services to Hong Kong client laboratories that perform objective testing falling within the scope of accreditation scheme and meeting the HOKLAS criteria of competence in accordance
with ISO/IEC Guide 25 which also contains all quality system elements of ISO 9000 related to laboratory operation for calibration and testing activities.

**Hong Kong Accreditation Service (HKAS)**

Apart from HKQAA, the other overseas certification bodies providing certification services for ISO 9000 in Hong Kong are supervised by the “accreditation bodies” in their own countries. In line with the current international trend in which a single government-supported organization provides accreditation to both laboratories and certification bodies on a voluntary basis, the Hong Kong Laboratory Accreditation Scheme (HOKLAS) has been expanded to form the Hong Kong Accreditation Service (HKAS) in November 1998.

HKAS now runs three accreditation schemes:

- Hong Kong Laboratory Accreditation Scheme (HOKLAS) – well established by serving the industry since 1985
- Hong Kong Certification Body Accreditation Scheme (HKCAS) – launched in November 1998
- Hong Kong Inspection Body Accreditation Scheme (HKIAS) – launched in December 1999

HKAS has been working towards the concept of “one test, one accreditation, accepted the world over” by becoming a member of other accreditation bodies such as International Accreditation Forum (IAF), International Laboratory Accreditation Cooperation (ILAC), Pacific Accreditation Cooperation (PAC) and Asia Pacific Laboratory Accreditation Cooperation (APLAC).

The principal aims and objectives of HKAS are:

- to upgrade the standard of operation of certification bodies, inspection bodies and laboratories.
- to offer official recognition to competent certification bodies, inspection bodies and testing and calibration laboratories which meet international standards.
- to promote the acceptance of certifications by accredited certification bodies, reports issued by accredited inspection bodies and test results issued by accredited laboratories.
- to establish mutual recognition agreements with overseas accreditation bodies on the equivalence of accreditations.
- to eliminate the need for re-certification and re-testing, thereby reducing costs and facilitating free trade.

**Hong Kong Certification Body Accreditation Scheme**

Hong Kong Certification Body Accreditation Scheme (HKCAS) officially came into being with the formulation of the Hong Kong Accreditation Service (HKAS) on November 2, 1998, to offer accreditation to ISO 9000 quality system certification bodies in compliance with the requirements of ISO/IEC Guide 62, quality management system (QMS) certification, those which conform with the requirements of ISO/IEC Guide 66 for environmental management system (EMS) certification and accreditation of certification bodies which conform with the requirements of ISO/IEC 65 for product certification.
Within the same month of launching HKCAS, i.e., November, 1998, HKQAA applied for accreditation and eventually (in June 1999) became the first body to be accredited by HKCAS. Applying for such accreditation is not new. HKQAA has been accredited by China National Accreditation Committee for Registrars (CNACR) for ISO9000 certification, and United Kingdom Accreditation Service (UKAS) for ISO9000, ISO14001, QS-9000 certification. This year, HKQAA is admitted to International Quality Network (IQNet) as a full member, being the 29th member worldwide, and the 4th member in Asia, after Japan, Korea, and Singapore.

Hong Kong Inspection Body Accreditation Scheme (HKIAS)

This is a voluntary accreditation scheme for inspection bodies that has the objective of upgrading their standard and recognising competent inspection bodies. Product inspection bodies support the trade and industry sector by examining the compliance of goods and products according to specifications provided by their clients, which may be overseas buyers, local buyers, manufacturers or in-house clients. Inspection operations include obtaining samples according to predetermined sampling plans and testing the samples for compliance. The dependability, competence and integrity of product inspection bodies are crucial to maintaining the quality of goods manufactured by or traded through Hong Kong and for upholding the reputation of Hong Kong as a reliable trading partner and service provider. Providing an accreditation service for inspection bodies will improve their quality and increase the confidence of overseas clients on their inspection results and the quality of the inspected goods.

Discussion of Problems and Future Trends

The vision of Hong Kong quality proponents has been that, under tight surveillance from both the certification bodies and internal auditors, the quality of works can be guaranteed, and the preferential tendering eligibility system can effectively bar the poor quality performance contractors and prevent them from obtaining contracts with a low tender price. However, as reported by Kam and Tang (1997), it seems that actual achievements resulted from such quality initiatives are below the original expectations.

Problems in Quality Management Efforts

Over a decade of ISO 9000 certification, there is still no apparent solution to the problems of the construction industry. Although some benefits were experienced by contractors after the implementation of the quality system (Tam, 1996), studies have shown that many of the problems and difficulties encountered by contractors still exist (Tam and Tong, 1996; Ahmed et al., 1998). The results obtained from different studies conducted in Hong Kong are best summarized by Kumaraswamy and Dissanayaka (2000). In summary ISO registration alone does not lead to a more efficient quality system. Rather, it is the genuine motive, combined with correct interpretation, formulation and implementation of ISO 9000 that yields the expected results.

Though there were reports of a downward trend in non-conformances and an upward trend in the PASS scores initially, PASS scores remained stagnant and no rising trend could be found since July 1995 (Tam et al., 2000). In an analysis of 150 public housing projects representing a total of 41 building contractors for the period between July 1994
and June 1998, Tam found that only a few contractors could achieve the desired quality levels and the remaining contractors fell far below the performance criteria. Over the years, nevertheless, there surfaced numerous complaints of poor quality of construction by ISO 9000 certified contractors having scored high PASS scores. Complaints also used to flow in from the contractors that, notwithstanding the implementation of PASS and preferential tendering, some contractors used to obtain contracts at questionably low tender prices. Tam concluded that eligibility for tendering future contracts based on PASS scores could not provide enough incentive for contractors to improve construction quality. Much concern was raised in 2000, when substandard piling incidents occurred in HA’s building construction projects. The events prompted that all concerned parties need to seriously rethink their approach towards construction quality management.

Future Trends

The followings are major trends towards addressing these problems:

1. reducing labour intensive site work by using offsite production and fabrication, and use of mechanisation onsite
2. applying the strategy of partnering to better manage the supply chain
3. others

1) Offsite Production/Fabrication and Use of Mechanisation

Shortage of skilled labour continues to be a serious problem affecting the progress of work on most of the building sites. In the extremely dynamic environments that prevail in construction sites, it is difficult to apply quality assurance procedures to manage workmanship quality. As a result, there is a growing preference towards using precast concrete and prefabricated components that would reduce site work. Typical components used in public housing are precast facades, slabs and staircases (HKHA, 2003). Another important trend is the use of mechanisation such as large panel formwork, tableform, tunnel form, climbform, slipform, and so on. An important advantage of the use of offsite fabrication/production and mechanisation, considered by its proponents, is that such technology forces the project participants to plan and co-ordinate the design aspects and solve any problems before moving to the site, and promotes engaging the contractor at the earliest possible stage. Problems with onsite poured concrete and onsite welded steel structures is that it is very forgiving for lack of proactive thinking at the beginning of the project.

2) Partnering the Supply Chain

Project partnering is a non-contractual agreement among the project participants, to manage contracts in a way that is thought beneficial for all parties, thus bringing about a win-win scenario and putting the handshake back into business. It is felt that the adversarial cultures present in most construction project environments today preclude realising project objectives. It is, in fact, not considered a new system at all, but the way business was carried out before industrial relations were so formalised.

The concept of partnering emerged in the construction industry in the late 1980s, and has been first used in Hong Kong, in 1994, in the project to design and build the 620-bed North District Hospital in Sheung Shui, Northern New Territories (Skues, 1996). Being a
public sector project, the design and build contractor needed to be selected by public tender, hence, partnering could only be applied after signing the contract, i.e., ‘Post-contract Partnering’. Although benefits of post-contract partnering are limited compared to ‘Pre-contract Partnering’, the high quality outcome of the building stands testimony to the success.

In 1997, two private commercial developments in the heart of the city, ‘1063 King’s Road’ and ‘11 Chater Road’ projects applied ‘Pre-contract Partnering’ strategy. The client engaged the contractor at the outset of the project and negotiated a Guaranteed Maximum Price (GMP) in a partnering environment. Among the many benefits reported are proactive project management, ease introducing changes, extensive use of offsite fabrication/production, superior quality and early completion of the project achieved below the target price.

In another example, the Mass Transit Railway Corporation (MTRC), being a semi-governmental organisation applied post-contract partnering in its Tseung Kwan O railway line construction projects. MTRC reported that the use of partnering has led to 40% cost savings and early completion of the project (Bayliss, 2001).

In view of this favourable trend, and considering many other industry conditions, the Construction Industry Review Committee (CIRC) report, in January 2001, has recommended partnering as a strategy to manage for quality in the construction industry (CIRC, 2001).

(3) Others

In order to substantially lift the quality and cost-effectiveness of the construction industry, a package of recommended measures were suggested by the CIRC. Some of the recommended measures are:

- more structured site supervision requirements
- use of independent laboratories for materials testing
- clearer accountability of all members of the project team
- realistic project durations

REFERENCES


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