

A Study of ISO9000 Implementation and Quality Management Practices in Hong Kong Construction Industry

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Abstract

Many studies reported that some organizations experience benefits of quality as well as the productivity due to the implementation of ISO9000. However, there are significant differences across countries, industries and organizations. This paper examines the current quality management practices in the Hong Kong construction industry under the ISO 9000 environment by a postal survey. It focuses on the success factors of ISO9000 implementation in the industry. The findings support the views that changes in the organization are needed to realize the benefits brought by ISO9000.

Key words: Hong Kong construction industry, ISO 9000, change

1. Introduction

1.1 Background

The Hong Kong Construction Industry is often featured by its “complexities” (e.g. multi-layer subletting and extreme tight working schedule), “reluctance to change” (e.g. poor ethics, lax attitude and indifferent culture) and “resistance to innovation” (e.g. lack of technical know-how).[1,2,3] Critics, such as weak leadership and lack of

innovation, are always quoted in the media [3,4]. Quality practices such as Total Quality Management (TQM) and ISO 9000 quality system standards have been reported to play important roles in enhancing performance in manufacturing as well as service industries. In fact, the construction industry is lagging behind in adopting the modern quality practices [5]. Hence, many people have advocated that the construction industry needs to borrow and adopt the quality

concepts and practices from both the service and manufacturing industry [5,6,7]. Based on a study in Singapore, Low and Lim [6] claimed that ISO 9000 had brought the following benefits to the construction industry in Singapore:

- Meet customer expectations;
- Better communication between the main office and the construction site;
- Able to implement other quality system e.g. TQM;
- Improve quality of workmanship;
- Reduce operation cost;
- Improve competitive advantage;
- Improve employees' morale.

1.2 Quality Problems in Hong Kong Construction Industry

In November 1984, the Hong Kong Housing Authority (HKHA) had declared to demolish 26 of 577 public housing blocks, which were built between 1963 to 1975 [10]. These buildings suffered from serious structural safety problem. Bribery was found to be the main reason behind this malpractice. As a result, these buildings were knocked down and were rebuilt because the cost of repairs and maintenance exceeded far more than the cost to rebuild them.

Since 1988, under the HKHA's demand on the compulsory adoption of ISO 9000

quality system, ISO 9000 had become a compulsory requirement for construction companies if they want to bid for the government projects. This requirement was officially enforced in 1993 [1,11]. Despite this, defects from the ISO 9000 accredited contractors are still remarkable in various degrees. For instance, Shui On, the first ISO 9000 accredited building contractor in Hong Kong, had wrongly connected a fresh water pipe to a system of seawater pipe in one of its building projects for the HKHA. In fact, this is just a relatively small defect caused by the lax attitude of the workforce. However, this incident had caused Shui On's banning from tendering HKHA projects for three months.

The Sha Tin piling scandal at Yuen Chau Kok Estate is another case of mal-practice and lack of supervision from an ISO 9000 accredited contractor, Zen Pacific [12]. In this incident, Zen Pacific was the main piling contractor at Yuen Chau Kok Estate where a large number of faulty pilings were found. Consequently, HKHA decided to pull down two 34-storey blocks at a cost of US\$30 million. To this end, a subsequent independent investigation headed by John Strickland, the former HSBC Bank Corporation chairman, also blamed nine Housing Department staff for failing to monitor the piling works. Moreover, further outstanding problems at Hong Kong public

housing flats were found in Tin Shui Wai, Tung Chung and Kwai Chung. The Tung Chung and Kwai Chung incidents involved the use of substandard reinforcement bars, while the Tin Shui Wai case also concerned defective piling [13]. A similar piling scandal happened in the private sector. In the construction of a cement factory at Yuen Long, the piling contractor was charged by the Independent Commissioner Against Corruption (ICAC) for changing the drill-in piling by driven-piling, which is a low-grade option. Furthermore, these defective piles were not found at the rock stratum as required by the Building Authority [14].

In fact, all those concerned Hong Kong construction organizations are ISO 9000 accredited for more than 5 years. They indeed have their own ISO 9000 quality system for all the employees to follow. Yet it appears that all such organizations do have problems in various degrees either in their adoption of quality systems or their employees are lacking commitment to implement the system. This is the main imitative of the research reported in this paper.

1.3 Characteristics of contractors in Hong Kong Construction Industry

Based on literature reviews and observations of the authors, the following

features are determined for the contractors of the Hong Kong Construction Industry. All these characteristics form the basis for the development of the research hypotheses, which will be discussed in next section.

High degree of labor-intensive;

- Shop floor staff usually less-educated and unskilled [2];
- Weather has a dominant influence on construction projects;
- Rotten multiple layer of sub-contracting [2];
- Poor ethics and lax attitude [2];
- Risky and unpleasant working environment [15];
- Inefficient working practices and construction methods [15,16];
- Poor image and sub-standard performance [15];
- Lack of effective supervision system [2];
- High unforeseeable risks e.g. insufficient information from client [2];
- Lowest tender bids [15].

2. Research Hypotheses

2.1 Quality system and top management's commitment

Mo and Chan [17], Parsa and Keivani [18], Thelen [19] and Endrijonas [20] all suggested that the implementation of ISO

9000 in an organization can bring about a certain degree of benefits such as better production performance and better quality awareness from the employees in diverse industries. It is also obvious that a successful implementation of ISO 9000 in an organization is closely related to the amount of effort provided by the top management. Levinson [22] put forward that a consensus by the top management is a must for an implementation of a quality improvement in an organization.

In the context of Hong Kong Construction Industry, though the ISO accreditation may not guarantee better quality performance, this is generally deemed to be an indicator of quality performance. Some clients, such as the HKHA and the Hong Kong Government Works Bureau, adopt this as one of their essential contractor pre-qualification criteria [1,11]. Singapore government had made ISO 9000 certification mandatory for the contractors and consultants who wish to bid for government construction projects [6]. Similarly in Sweden, since 1995, the Swedish Authorities had demanded under building law that contractors should have responsibility to adopt ISO 9001 in construction projects [5]. In fact, as pointed out by many people, like Landin [5], it is extremely useful to have a common system (i.e. ISO 9000) in which every construction

organization to follow.

However, Kumaraswamy et al [1] argued that ISO 9000 accreditation is often used as a 'passport' for showing a capacity to meet the client's requirements in quality with little 'real' attempts to actually improve performance. Similarly, based on a study on the UK Construction Industry, Shamma-Toma [8] pointed out that there was no strong evidence to show that the top management was committed to improve quality in many construction organizations. In Australia, according to Love [9], many construction organizations take the ISO certification for wrong reasons: because they see that everybody else is doing it or because it is supposed to improve performance.

In short, it is true that different construction organizations may take the ISO 9000 certification for different purposes and that the top management's commitment is critical in the implementation of ISO 9000 in an organization. Hence, our research study first tested:

Hypothesis 1: Most Hong Kong construction organizations adopt ISO 9000 with an intention to improve their performance and to meet the client's demand.

Hypothesis 2: Top management's genuine commitment is needed for the successful implementation of ISO 9000.

2.2 ISO 9000 as a paperwork exercise

Additional records or paper work required by the ISO 9000 are often treated as the proofs that the organizations have carried out in accordance with the adopted quality system in the organization. However, the increasing paperwork becomes a major barrier to ISO 9000 implementation. This view is supported by many scholars (e.g. see [6,7,25]). Referring to the piling scandal case at Yuen Chau Kok Estate, the independent investigation headed by John Strickland found out that the concerned project engineer of the Housing Department had concentrated on his paperwork only [4] in order to compile with the requirement of records. As a result, the project engineer had delegated all the important monitoring and supervision work to his subordinates (e.g. inspectors of works and the work supervisors). In fact, some employees just treat that the ISO 9000 is a paperwork exercise and such belief is misleading and will not bring forward any quality improvement in an organization. Hence, the research project studied:

Hypothesis 3: In Hong Kong, some construction organizations, the employees

just treat ISO 9000 system as a paperwork exercise.

2.3 Training of employees

In the study, training means the training of employees in the technical skills, human relationship as well as the ethics in the construction industry. Based on a study on a number of Hong Kong and Chinese companies, Cheng and Tummala [26] claimed that employee involvement was critical and paramount in the implementation of ISO 9000 quality system. Training of the employees was an example of employee involvement in the organization. In fact, training provided to personnel of all levels is a critical factor in the implementation of ISO 9000 [27]. Similarly, Spencer et al [28] claimed that training resource and training skills is a critical factor in the quality management practices in some manufacturing organizations in modern China.

Regarding the piling scandal case at Yuen Chau Kok Estate, the independent investigation stated that many supervisory staff, such as chief technical officers and inspectors of works, were lacking of professional expertise in construction and that they adopted an indifferent attitude towards the mal-practice of the piling contractor [4]. In the context of the lax attitude of the employees in the Hong Kong

Construction Industry, the former HKHA chairwoman, Wong Yick Ming, pointed out that companies were lacking of ethics in their performance. Hence, it is suggested that the construction site workers and supervisors should be trained on professional ethics and conduct by training agency such as Construction Industry Training Authority, CITA [29].

In addition, similar concerns about the training needs of supervising staff and the shopfloor workers are also shared by Tang Ying Yen, the chairman of the Construction Industry Review Committee [30], and Tong Yat Chu, the executive director of the CITA [2]. Furthermore, Lau Chu King, chairman of the training board of the Vocational Training Council of Hong Kong, pointed out that the management and the supervising staff of most Hong Kong construction organizations are lacking human resource skills and leadership and that 75% of such organizations have no training programme for this level of employees [3].

In short, since many workers are often involved in a construction project and that most of the shop floor workers are less educated and unskilled. So continual training is needed during the project in order to improve the quality as well as the production performance. Hence, the research

project studied:

Hypothesis 4: During construction period, continual training in technical skills is needed for the enhancement of the quality performance.

2.4 Internal audit

Internal audit is an important element in the ISO 9000 quality system. To this end, a continuous internal audit of the quality system together with committed corrective action can certainly help an organization to achieve continuous improvement. So, Sakofsky [31] suggested that internal audit could facilitate process improvement by identifying weak segments in process chains. In addition, Landin [5] claimed that internal quality audits play an important role in the monitoring the workmanship quality in the construction industry.

Low & Lim [6] claimed that in the construction industry documented procedures are needed to prevent non-conforming or defective products from being delivered or installed on construction sites via identification, segregation and disposal of non-conforming product. Moreover, documented procedures are needed for standard operating procedures and instructions in construction such as casting of concrete or setting up of formwork. In this way,

internal audits are needed to monitor the effectiveness of these documented procedures. Hence, the quality of workmanship is improved.

In simple terms, the practice of internal audit is a useful tool carried out to locate any problems within the production process. The corrective actions to any identified problems can then be implemented in order to improve the quality as well as the production performance. Therefore, the project studied:

Hypothesis 5: Internal audit is an effective practice throughout the construction duration.

2.5 Culture of Hong Kong Construction Industry

According to Mo and Chan [17], cultural issues and technical issues are the main obstacles to ISO 9000 for small to medium organizations in Australia. Surprisingly, Shammass-Toma et al [8] pointed out that the UK construction culture was far from being devoted to quality improvement, is often dominated by short-term financial considerations as reflected in uncooperative and suspicious relationships among the employees.

In the aspect of site supervision in Hong

Kong Construction Industry, Tam and Ho et al [7] stated that it is difficult to educate the employees who have established their own traditional working habit. These inflexible employees may bypass the checking procedures by just certifying the documents without any actual checking. This shows that quality can be improved if the checking procedure is properly followed. To this end, a cultural change in the employees' belief is required. Furthermore, Tam and Ho claimed that the culture issues are critical to the construction quality and it is the lack of a cultural foundation in the present ISO 9000 quality management may account for the current rejection of quality management initiatives in the Hong Kong construction industry. In fact, some Hong Kong studies also supported this view [32].

In order to upgrade the quality in the Hong Kong Construction Industry, Tang Ying Yen [33] proposed to revamp the practice of subcontracting in construction projects. To this end, the committee also proposes amending legislation to hold subcontractors responsible if site problems occur. His main proposals include:

- Independent technical audits to be carried out regularly as construction proceeds;
- Public housing projects to be brought into scope of Building Ordinance;
- A contractor's past performance to be

considered during tender bidding;

- Continual training to be made a prerequisite for renewal of professional membership;
- Introduction of new construction method such as pre-cast concrete construction;
- Promote change cultural and ethics in construction industry;
- Registration of sub-contractors.

Referring to the characteristics of the Hong Kong contractors mentioned earlier, the above recommendations could serve as a solution to the Hong Kong traditional construction culture defined by these characteristics. Therefore, the Hong Kong Government Chief Executive Tung Chee-hwa commented the above recommendation is a "cultural revolution" in the local construction industry [33]. Hence, the study investigated:

Hypothesis 6: Implementation of ISO 9000 needs a quality supporting culture.

2.6 Problems and Changes in Hong Kong Construction Industry

Abdel-Razek [34] quoted that several studies in the UK and USA recognized that problems in the construction industry needed rapid improvement [35,36]. In these studies, examples of these problems are: inadequate information, poor communications, poor care in workmanship, and lack of site

supervision. In addition to the previously mentioned characteristics of the contractors, Tang Ying Yen [30] pointed out that the Hong Kong construction industry has the following major problems:

- High accident rate regarding the safety issues of the workers in construction sites;
- High construction cost;
- Insufficient training for employees;
- Outdated management skills;
- Lacking of environmental knowledge.

Similarly, based on the findings from the Yuen Chau Kok Estate piling scandal case, John Strickland identified the problems from the HKHA and the piling construction is as follows [4]:

- Indifferent to the malpractice during construction;
- Supervising staff of the Housing Department are lacking of professional expertise;
- Negligence of the project staff of the Housing Department.

With respect to the quality of public housing in Hong Kong, the Secretary for Housing, Wong Shing-wah claimed that inspectors alone would not improve the quality of public housing [38]. In addition, Tse Lai-leung of the Hong Kong Construction Association stressed that quality

workers are the foundation for quality buildings in Hong Kong [39]. Ir Luk, President of Hong Kong Institution of Engineers [40] said, "As professional engineers in this industry, how would you like to see your role? We cannot just sit back and expect changes to occur. We must get up, speak out and take the initiative to make change." Hence, reforms for the Hong Kong construction industry are necessary.

Leonard [41], Franklin [42] and Gatchalain [43] claimed that changes (e.g. people empowerment and team working) could bring about some benefits to an organization. Furthermore, Zairi [44] identified that the fundamental factors such as commitment, clear objectives, customer orientated are vital for continuous quality improvement for organizations in the UK. Likewise, this view is also shared by Ahmed et al [45]. According to Abdel-Razek [32], the critical areas for changes in construction industry are: improvement of employees' satisfaction, improvement of training and learning, and improvement of company processes and regulations and improvement of quality systems. Likewise, Low and Lim [6] proposed to introduce new quality initiatives (e.g. ISO 14000), simplify documentation, review data and records, have less paperwork, and allow flexibility.

In simple terms, there are many problems in the Hong Kong Construction Industry and these imply that changes are needed for survival in this industry. For example, cultural and attitudinal changes of the people for accepting and producing quality [7]; and a structural change in organizational system (e.g. reduce the paperwork in ISO 9000 by means of information technology, etc.) [6]. Hence, it needs to test:

Hypothesis 7: Problems in the construction organizations implies that there is a need of culture and structural changes in the organization.

Hypothesis 8: Cultural and structural changes can improve the performance of quality.

3. Methodology

3.1 Postal survey

A postal questionnaire survey was conducted aiming at the Hong Kong construction organizations to seek information about their quality management practices. There are three categories of construction organizations in Hong Kong, namely (1) consultants/ government departments, (2) contractors, and (3) suppliers. In this survey, the consultants and the Hong Kong government departments is

classified as the 'consultant'; whilst the contractors, the specialist contractors and the suppliers shall be referred as the 'contractor'.

The survey was intended to identify the present practice as adopted by the Hong Kong construction organizations for the ISO 9000 implementation. In an attempt to achieve a better response, the questionnaires were sent to the management level, such as quality manager, engineering managers and engineers of the construction organizations. Respondents were provided with self addressed pre-paid envelopes and a standard letter explaining the objective of the survey. Furthermore, a statement on the reassurance on the confidentiality of the data was provided. Reminder letters were sent to those organizations, which gave no response from the first letter.

3.2 Sample size

The Directory of Hong Kong Builders 2000 and the Hong Kong Institution of Engineers 2000 Yearbook contain a list of addresses of the contractors and the consultants operating in Hong Kong. Both the Directory and the Yearbook also provides some background information on the construction organizations. In 2000, there is about 1000 contractors operating in Hong Kong, whilst, the number of active consultants in Hong Kong is around 80.

Based on a population size of 1,080 construction organizations in Hong Kong, a target sample size of 200 based on 95% confidence level. Assuming a general response rate of 20%, an overall target sample size of 500 was chosen in order to generate sufficient response for drawing a realistic conclusion from a statistical point of view. Therefore, a set of structured questionnaire was sent to 500 organizations, which were randomly selected from the Directory of Hong Kong Builders 2000 and the Hong Kong Institution of Engineers 2000 Yearbook.

3.3 Questionnaire

The questionnaire consists of 2 parts. The first part includes 2 questions dealing with the reasons for the organization to adopt ISO 9000 and its duration. The respondents just choose their preference. No score scale is provided for these two questions. The second part of the questionnaire includes 11 questions to examine the information on:

- current quality practice for ISO 9000;
- management's commitment, effort for ISO 9000;
- employees' attitude towards ISO 9000;
- training of employees and internal audit;
- organizational problems and potential changes to introduce.

The five-point Likert scale was used for

question 3 to question 13. Two different scales were used in the respondents' preferences. A five-point scale from "strongly agreed (5)" to "completely disagreed (1)" is being chosen to guide the respondent on opinions. Another five-point scale ranging from "excellent (5)" to "very poor" is used to priority system adopted in an organization. Before the mass survey, a pilot test was carried out to examine the validity of the questions.

4. Hypothesis Tests

The total number of survey responses is 162 out of 500 sent-out questionnaires. The response rate was 32%, which is quite satisfactory as compared with similar surveys in Asia. Out of the 162 responses, 144 (89%) were identified as contractors, including main contractors, specialists and suppliers; while only 18 (11%) were consultants, including engineering consultants and Hong Kong government departments. The 18 responses can be considered to represent the general view of the total 80 consultants in Hong Kong, i.e. 23% of the population, 18/80. The survey result of the 18 responding consultants showed that the consultants hold a similar view as the 144 responding contractors. Hence, an overall view of combining 144 contractors and 18

consultants is used in the following analysis. A statistical tool, SPSS (Statistical Package for the Social Sciences), was employed to compute the survey results. In this study, the proposed hypotheses are to be tested from frequency counts or from association using Pearson's chi-square analysis. The survey results corresponding to the 8 hypotheses are tabulated in the Table 1-3.

Hypothesis 1 (H1) : Most Hong Kong construction organizations adopt ISO 9000 with an intention to improve their performance and to meet the client's demand.

Table 1 identifies the reasons for the Hong Kong construction organizations to adopt ISO 9000 quality standard. 44.4% of the respondents adopt ISO 9000 for organizational performance improvement, whilst 35.2% accounts for meeting the customer's need. Hence, this implies that these two issues appear to be the main driving forces for Hong Kong construction industry to seek for ISO 9000 certification. Table 2 shows the duration of the organizations for the implementation of ISO 9000. Only 9.9% of the respondents are waiting for ISO 9000 accreditation. This implies that in most of the Hong Kong construction organizations have already adopted the ISO 9000 quality system. These

findings are in good supportive agreement with the Hypothesis 1. resources provided (Chi-square=84.99, $p<0.05$); and the training of employees (Chi-square

Table 1: Why most local construction organizations adopt ISO 9000? (N=162)

(a) Meet customer's demand	35.2%
(b) Promote company's image	30.2%
(c) Increase market share	24.7%
(d) First step towards TQM	13.6%
(e) Quality performance improvement	44.4%

N.B. Due to the fact that each respondent may have more than 1 choice, hence the cumulative percentage may exceed 100%.

Table 2: Duration for implementation of ISO 9000 (N=162)

(a) Waiting for accreditation	9.9%
(b) Under 1 year	11.7%
(c) 1 to 2 years	25.9%
(d) 2 to 3 years	21.6%
(e) More than 3 years	30.9%

Hypothesis 2 (H2) : Top management's genuine commitment is needed for the successful implementation of ISO 9000. =63.21, $p<0.05$); and the monitoring and review (Chi-square=39.64, $p<0.05$). Hence, the Hypothesis 2 is supported.

Referring to Table 3, item b, the Hypothesis H2 suggested that genuine commitment of the top management is needed for the successful ISO 9000 implementation is confirmed. In this study, commitment of the top management is measured by the variables such as resources provided, training, and the monitoring and review. Significant relationship was found to exist between the commitment and the

Hypothesis 3 (H3): In Hong Kong, some construction organizations, the employees just treat ISO 9000 system as a paperwork exercise.

With regard to Table 3, item c, the hypothesis suggested that in some accredited organizations, the employees treat the ISO 9000 system is a paperwork exercise is confirmed. In this respect, the survey result

Table 3: Hypotheses (N=162)

Hypothesis	Whether confirmed	Support
a. Most local construction organization adopt ISO 9000 with an intention to improve their performance and to meet the client's demand.	Confirmed	44.4%
b. Top management's genuine commitment is needed for the the implementation of ISO 9000.	Confirmed	Chi-square 84.99, 63.21,39.64
c. In some construction organizations, the employees just treat the ISO 9000 system as a paperwork exercise.	Confirmed	87%
d. During construction period, continual training is needed for the enhancement of quality performance.	Confirmed	Chi-square 191.89, 143.46,149.09
e. Internal audit is a good practice throughout the construction duration.	Confirmed	Chi-square 107.05,84.09
f. Implementation of ISO 9000 needs a quality supporting culture.	Confirmed	Chi-square 43.29, 52.93,59.42,61.54
g. Problems in a construction organization implies that there is a need of reform.	Confirmed	Chi-square 117.64, 72.41,105.93
h. Changes can improve the quality performance.	Confirmed	Chi-square 43.05, 60.15,44.81,95.38

identified that a total of 87% respondents (59.9% agreed, 18.5% very agreed and 8.6% completely agreed) opined that ISO 9000 system is just a paperwork exercise. Though this is a misconception, a large number of employees in the construction industry still bear this impression.

Hypothesis 4 (H4): During construction period, continual training of technical skills is needed for the enhancement of the quality performance.

Referring to Table 3, item d, the Hypothesis H4 suggested that a continuous

and sufficient training is needed for the improvement of employees' performance is confirmed. In this study, continual training is measured by the variables such as organizational need, increased morale and reduced errors. Significant relationship was found to exist between the sufficient training and the organization's need (Chi-square=191.89, $p < 0.05$); and the increased morale (Chi-square=143.46, $p < 0.05$); and the reduced error (Chi-square=149.09, $p < 0.05$). So, H4 is supported.

Hypothesis 5 (H5) : Internal audit is an effective practice throughout the

construction duration.

In Table 3, item e, H5 suggested that internal audit is a good practice to be adopted throughout the construction is confirmed. In this study, the variables such as identification of quality tools and the job and skill training were used to measure the practice of internal audit. Significant relationship was found to exist between the internal audit and quality tools (Chi-square = 107.05, $p < 0.05$); and the job and skill training (Chi-square = 84.09, $p < 0.05$). Therefore, H5 is supported.

Hypothesis 6 (H6): Implementation of ISO 9000 needs a quality supporting culture.

In Table 3, item f, this hypothesis suggested that quality culture is needed for a successful implementation of ISO 9000 is confirmed. In this study, the quality culture is measured by the variables such as prevent problem, continuous improvement, reliable service and meeting the client's requirement. Significant relationship was found to exist between the implementation of ISO 9000 and prevent problem (Chi-square=43.29, $p < 0.05$); continuous improvement (Chi-square=52.93, $p < 0.05$); reliable service (Chi-square=59.42, $p < 0.05$); and meet client requirement (Chi-square=61.54, $p < 0.05$). Hence, H6 is supported.

Hypothesis 7 (H7): Problems in the construction organizations implies that there is a need of culture and structural changes in the organization.

With reference to Table 3, item g, the Hypothesis suggested that problems in an organization are related to the need of change is confirmed. In this study, the existence of problems is measured by the variables such as need of improve performance, wastage and rework. Significant relationship was found to exist between the need of change and need to improve performance (Chi-square=117.64, $p < 0.05$); wastage (Chi-square=72.41, $p < 0.05$); and rework (Chi-square=105.93, $p < 0.05$). So, H7 is supported.

Hypothesis 8 (H8): Cultural and structural changes can improve the performance of quality.

Referring to Table 3, item h, this hypothesis suggested that changes can improve the performance of quality is confirmed. In this study, the type of changes is measured by the variables such as reductive change, increasing change, stabilizing change, keeping change and information system. Significant relationship was found to exist between the performance of the employees and reductive change

(Chi-square=43.05, $p<0.05$); and the increasing change (Chi-square=60.15, $p<0.05$), the stabilizing change (Chi-square=44.81, $p<0.05$), the keeping change (Chi-square=36.46, $p<0.05$); and information system (Chi-square=95.38, $p<0.05$). Therefore, H8 is supported.

5. Factor analysis

Factor analysis was applied to study the correlations among variables. Factor loadings were calculated as the correlations of the variables with the factors. Factor loadings are considered as "high" if their absolute values are greater than 0.6, whilst any loading smaller than 0.5, regardless of positive or negative, can be ignored. [46] A variable that has a high factor loading will be critical to the concerned factor. In addition, factors were identified using the principal component procedure; and the solution was rotated using the oblimin procedure because we assume that there may have some associations among the factors. In this paper, only factors with eigenvalue greater than 1 was included using the principal component method. An oblimin rotation was used to see how the individual variables are related to those identified common factors resulting a set of factor loadings. The results of the factor analysis are tabulated in the Table 4-7.

5.1 Factor analysis of training areas

Table 4 shows the factor loadings from the factor analysis of training areas for the employees. Inspection of the loading reveals that all variables, except one, load clearly on just one factor. The exception is 'statistical technique' which loads on both Factor 1 (0.65) and Factor 2 (0.57). These loadings indicate Factor 1 is relatively more important than Factor 2.

As shown in Table 4, Factor 1 includes the variables having high loadings ranging from 0.65 to 0.78. To this end, Factor 1 has a high loadings for the training areas of 'job and skill training (0.78)', 'quality related tools to managers (0.74)', 'human relationship techniques (0.70)', 'safety at work (0.68)', 'statistical techniques (0.65)'. These are the traditional training areas that will affect individual job and enhance better quality in the employees' performance. In this respect, we might be labeled this group of variables as 'Tradition' that has a strongest correlation with 'job and skill training'.

Factor 2, includes: the training areas of 'communication skills' (loading=0.74), and 'quality circle' (loading=0.73). This group of variables might be best labeled as 'Communication', because these areas will definitely require the upward and downward communication as well as across the

company. Hence, the 'communication skill' has the strongest correlation with Factor 2. In addition, an oblimin rotation of the two factors showed that the factors are distinct (i.e. low correlation): 0.25 between 'Tradition' and 'Communication'.

Table 4: Factor loadings from factor analysis of training areas for employees towards ISO 9000 (N=162, Alpha = 0.77)

	Tradition (Factor 1)	Communication (Factor 2)
1. Quality Circle	-0.01	0.73
2. Quality related tools to managers	0.74	0.10
3. Statistical techniques	0.65	0.57
4. Team working	0.58	0.45
5. Communication skills	0.43	0.74
6. Human relationship techniques	0.70	0.37
7. Safety at work	0.68	0.02
8. Job and skill training to objective	0.78	0.13

5.2 Factor analysis of quality practice

Table 5 shows the factor loadings from the factor analysis of quality practice adopted for ISO 9000. Inspection of the loadings in the rotated matrix reveals that the variables, 'everyone involved quality', 'Work to objective', 'Prevention of problems', 'Quick response to client', and 'Effective quality system' are loading on both factor 1 and factor 2.

As shown in Table 5, Factor 1 includes: 'work to objective' (loading = 0.82), 'continuous improvement' (loading = 0.81),

0.69), 'everyone involved quality' (loading=0.67), and 'recognition for superior quality' (loading=0.64). These imply a restructuring of the organization, for instance, a decentralization of the management unit. So, Factor 1 might be labeled as 'Restructure' factor that has a strongest correlation with 'work to objective'.

Factor 2, the critical loading includes: 'meet client's requirement' (loading=0.87), 'reliable service/product' (loading=0.84), and 'effective quality system' (loading=0.72). These areas will definitely require the

adopted quality tools to become customer focused. Therefore this group of variables might be labeled as 'Client orientated', which has a strongest correlation with 'meet client's requirement'. Moreover, an oblimin rotation of the two factors showed that the factors are correlated: 0.54 between Factor 1 and Factor 2.

the factor analysis of practice of internal audit adopted for ISO 9000. Inspection of the loadings in the rotated matrix reveals that the variable 'auditors with general experience', loads on both factor 1 (0.68) and factor 2 (0.57). Hence, Factor 1 appears to be more important than Factor 2.

Table 5: Factor loadings from factor analysis of the Quality practice for ISO 9000 (N=162, Alpha = 0.91)

	Restructure (Factor 1)	Client Orientated (Factor 2)
1. Everyone involved Quality	0.67	0.55
2. Work to objectives	0.82	0.55
3. Prevention of problems	0.72	0.57
4. Company wide communication	0.70	0.43
5. Quality education and training	0.73	0.36
6. Continuous improvement	0.81	0.47
7. Right first time	0.69	0.28
8. Quick response to client	0.70	0.52
9. Reliable service/product	0.49	0.84
10. Meet client's requirement	0.44	0.87
11. Recognition for superior quality	0.64	0.43
12. Cover organizational operations	0.79	0.32
13. Meet ISO 9000 requirements	0.48	0.24
14. Effective quality system	0.57	0.72

5.3 Factor analysis of practice of internal audit

Table 6 shows the factor loadings from

In Factor 1, the critical loading includes: 'resource provided' (loading=0.82), 'independent auditor' (loading=0.73), 'sufficient internal audit' (loading=0.68), and 'auditors with general

experience' (loading=0.68). These variables are important if effective audits are desired. So, this group might be labeled 'Success' which has a strongest correlation with 'resource provided'.

The critical loading in Factor 2 includes: 'use of internal audit for ISO 9000' (loading =0.78), 'finding of audit' (loading=0.67), 'in-house training of auditors' (loading=0.62), and the 'internal audit is a good practice' (loading=0.61). These variables are generally

5.4 Factor analysis of practice of reasons for potential change

Table 7 shows the factor loadings from the factor analysis of the reasons for potential change. Inspection of the loadings reveals that the variable 'reduce turnover, absenteeism', loads on Factor 1 (0.78), Factor 2 (-0.51) and Factor 3 (0.52). This implies that Factor 1 appears to be more important than Factor 2 and Factor 3.

Factor 1 includes: 'better quality climate'

Table 6: Factor loadings from factor analysis of the practice of internal audit for ISO 9000 (N=162, Alpha = 0.79)

	Success (Factor 1)	General (Factor 2)
1. Top management commitment	0.50	0.06
2. Resource provided	0.82	0.14
3. Sufficient internal audit	0.68	0.49
4. Use of internal audit for ISO 9000	0.13	0.78
5. Internal audit is a good practice	0.14	0.61
6. In-house training of auditors	0.33	0.62
7. Auditors with general experience	0.68	0.57
8. Independent auditor	0.73	0.48
9. Findings of audit	0.48	0.67

accepted tools for internal audit. Hence, this group might be labeled as 'General' factor. Additionally, an oblimin rotation of the two factors showed that the factors are correlated: 0.33 between Factor 1 and Factor 2.

(loading=0.84), 'less conflict' (loading=0.79), 'reduce turnover, absenteeism' (loading=0.78), 'and understanding ISO 9000' (loading=0.70), 'less wastage' (loading=0.64). These variables form the main benefits from introducing changes in an organization. Hence this group might be labeled as 'Benefits' factor, which

has a strongest correlation with 'better quality climate'.

Factor 2 includes: 'less rework, cost, overrun' (loading=-0.86), 'less complaints' (loading=-0.80), 'control sub-contractors' (loading=-0.79), and 'less wastage'(loading=-0.77). These variables concern with turning the employees towards a better-disciplined behavior by introducing measures to change the involved employees. Hence, this group might be labeled as 'Disciplined' factor.

Factor 3 includes: 'increase production' (loading=0.93), and 'increase morale' (loading=0.81). These variables concerned with production orientated. Hence, this group might be labeled as 'Production' factor.

In addition, an oblimin rotation of the three factors showed correlation among these factors: -0.46 between Factor 1 and Factor 2, -0.36 between Factor 2 and Factor 3, and 0.36 between Factor 1 and 3.

6. Discussions and Conclusion

The result of this study showed that most contractors seek ISO 9000 for the reason of meeting the client's demand and of improving their performance. It also identified changes are related with the performance of employees of the contractors in Hong Kong. Other key factors for a successful implementation of ISO 9000 are:

- Top management's genuine commitment

Table 7: Factor loadings from factor analysis of the reasons for potential change (N=162, Alpha = 0.88)

	Benefit (Factor 1)	Disciplined (Factor 2)	Production (Factor 3)
1. Increase production	0.22	-0.26	0.93
2. Increase morale	0.58	-0.48	0.81
3. Reduce turnover, absenteeism	0.78	-0.51	0.52
4. Less conflict	0.79	-0.52	0.35
5. Better quality climate	0.84	-0.30	0.17
6. Understand ISO 9000	0.70	-0.35	0.34
7. Less wastage	0.64	-0.77	0.36
8. Less rework, cost, overrun	0.57	-0.86	0.39
9. Less complaints	0.45	-0.80	0.36
10. Control sub-contractors	0.21	-0.79	0.22

- Sufficient training of employees
- Internal audit
- A quality culture

In terms of training areas for the employees, factor analysis has identified that job and skill training, and the communication skill are critical. Referring to the quality practice, this study claimed that focus should be placed on organizational objective and on meeting client's requirement. With respect to internal audit, the study suggested that sufficient resource should be provided and that internal audit should be carried throughout the construction period. Furthermore, factor analysis has suggested change in an organization in order to obtain better quality climate, less rework and cost overrun, and better production performance. In fact, we might regard these as the three approaches for developing changes in order to improve the employees' performance.

To sum up, the ISO 9000 standards series has become and can form the basis for an efficient and effective quality management system in the HK construction industry.

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