Evaluation of Implementing ISO 9001:2000 Standard in the Construction Industry of China

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In December 2000, the new series of ISO 9000 standard was issued. This new quality management series carries some significant changes and modifications, bringing some impact and requiring adaptation for the current ISO 9000-certified organizations. This paper aims at investigating the problems in applying the new standard, with particular reference to the construction industry and its effects to the ISO 9000-certified organizations. Most certified firms, as revealed from the survey, opined that implementing ISO 9000 alone did not add much to quality improvement, while a combination of ISO 9000 and Total Quality Management (TQM) would contribute the most. The survey identifies that the main obstacle in reaping all the goodness of ISO 9000 standards is "the shortsighted goal of organizations in getting the certification". Most Chinese construction firms, as unveiled in the study, describe that the most effective quality management system should be "ISO 9000 integrated with TQM".

Introduction

Since the introduction of the ISO 9000 series in 1987, it has become a world-wide quality management norm for organizations, regardless of their sizes and products (Tsim *et al.*, 2002). Many studies reveal that effective implementation of ISO 9000 can benefit organizations through the improvement of management control (Carlsson and Carlsson, 1996; Lee, 1998), efficiency (Ebrahimpour *et al.*, 1997), productivity (Huarng *et al.*, 1999; Terziovski *et al.*, 2003), and customer services (Buttle, 1997; Yeung *et al.*, 2003). On the other hand, problems have been identified in implementing the 1994 version of the ISO 9000 standards, such as stringent compliance requirements (Karapetrovic, 1999), a high volume of paperwork (Mezher and Ramadan, 1999), and poor compatibility with other management systems (Dick, 2000; Terziovski *et al.*, 1997). The new version of the standards was released in December of 2000 and all organizations certified to ISO 9001/2/3:1994 are required to switch into the ISO 9001:2000 standards. As there are some significant changes in the new version, it may result in some impact and require some adaptation for the current certified organizations (Boulter and Bendell, 2002; Tsim *et al.*, 2002).

A number of studies on the implementation of ISO 9000:1994 in different parts of the world has been recorded, including USA (Yates and

Aniftos, 1997; Chini and Valdez, 2003), UK (Ramin *et al.*, 1999), Australia (Love and Li, 2000), France (Henry, 2000), Sweden (Landin and Nilsson, 1999), Singapore (Low and Fong, 2002; Kam and Tang, 1997), Hong Kong (Kam and Tang, 1997; Tam *et al.*, 2000a) and China (Zeng *et al.*, 2002). With the emergence of this new version of standards, it lacks research information and is worthy to evaluate its status of implementation and to solicit construction firms' views on its value along the path towards quality and any possible further improvements.

ISO 9000

The ISO 9000 series was originated from the military procurement standards in the Second World War, which ultimately led to the first civil quality management standard: BS 5750 of the British Standards Institution in 1979. In 1987, the British Standard BS 5750 was adapted with a few modifications and turned into the international standard of ISO 9000 (Boulter and Bendell, 2002). Although the international standard was updated in 1994, there was not much change until the new version in 2000, which to certain extent is a complete rewrite (see Table 1).

The ISO 9000:1994 standards consist of three auditable certification standards as ISO 9001/2/3. These apply correspondingly to organizations which 1) design their own products and services (20 clauses), 2) do everything with the exception of design (19 clauses), and 3) provide products and services that can be verified only by inspection and test (16 clauses). The ISO 9001:2000 standards integrate these three elements into ISO 9001, which places stronger emphasis on process management and resource management, and has commonality of architecture with ISO 9004, so that quality assurance requirements and quality management

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can be aligned holistically (Biazzo and Bernardi, 2003).

Methodology of Study

A postal questionnaire was designed to evaluate the status of implementation of the ISO 9001:2000 in construction in China from March to August 2003. Before the survey, auditors of ISO 9001 standard and senior management representatives of ten construction firms were interviewed to verify the questionnaire draft. Then a structured questionnaire survey was administered to the senior management representatives of 300 ISO-9000 certified construction firms with 77 completed and returned from 21 cities in China, among which 68 were effective without flaws at a response rate of 23%.

The questionnaire was set to investigate the following five areas containing 20 main questions:

- company profile;
- applicability of the ISO 9001: 2000 to the construction industry;
- effects on quality improvement;
- obstacles in implementing the standards for the construction industry; and
- perceived most effective quality management systems for the industry.

Profile of Companies in the Survey

All the responding 68 construction firms fall into two categories of ownership; 56 (82%) were state and collective-owned and 12 (18%) were privately-owned. In China, large construction firms are state and collective-owned establishments under the traditional planned economy system. In general, these firms have a larger number of staff and workers. In this survey, 46 firms employed more than 1,000 people (68%).

Respondents of the survey include 28 building engineering firms (41%), 22 building and civil engineering firms (32%) and 18 installation engineering firms (27%), among them 54 were in the first level of general contractor (79%) and 14 the second level- subcontracting (21%). Table 2 summarizes their status in implementing ISO 9000 standards.

In Table 2, 88 per cent of the respondents have administered ISO 9000 standards for over three years, revealing that most have rich experience. Overall, 64 per cent of the responding firms have

Table 1: Comparison of ISO 9000:1994 and ISO 9001:2000

ISO Standard:1994 Version			ISO Standard:2000 Version
ISO 9001	ISO 9002	ISO 9003	ISO 9001
4.1 Management responsibility	√	√	4 Quality management system
4.2 Quality system	√	√	4.1 General requirements
4.3 Contract review	√	√	4.2 Documentation requirements
4.4 Design control	—	—	5 Management responsibility
4.5 Document and data control	√	√	5.1 Management commitment
4.6 Purchasing	√	—	5.2 Customer focus
4.7 Control of customer-supplied product	√	√	5.3 Quality policy
4.8 Product identification and traceability	√	√	5.4 Planning
4.9 Process control	√	—	5.5 Responsibility, authority, and communication
4.10 Inspection and testing	√	√	5.6 Management review
4.11 Control of inspection, measuring and test equipment	√	√	6 Resources management
4.12 Inspection and test status	√	√	6.1 Provision of resources
4.13 Control of nonconforming product	√	√	6.2 Human resources
4.14 Corrective and preventive action	√	√	6.3 Infrastructure
4.15 Handling, storage, packaging, preservation and delivery	√	√	6.4 Work environment
4.16 Control of quality records	√	√	7 Product realization
4.17 Internal quality audit	√	√	7.1 Planning of product realization
4.18 Training	√	√	7.2 Customer-related processes
4.19 Servicing	√	—	7.3 Design and development
4.20 Statistical	√	√	7.4 Purchasing
			7.5 Production and service provision
			7.6 Control of monitoring and measuring devices
			8 Measurement, analysis, and improvement
			8.1 General
			8.2 Monitoring and measurement
			8.3 Control of nonconforming product
			8.4 Analysis of data
			8.5 Improvement

Table 2: Status of the responding firms in implementing ISO 9000 standards

Item	Number of firms		
Period of getting certification of ISO 9000 standards	<3 years	8	(12) ^a
	3~5 years	32	(47)
	>5 years	28	(41)
Total		68	(100)
Having finished transferring from ISO 9000: 1994 to ISO 9001: 2000 standard	<1 year	27	(40)
	1~2 years	14	(21)
	>2 years	2	(3)
Directly implementing the new standard	Yes	11	(16)
On the way in transferring from ISO 9000: 1994 to ISO 9001: 2000	—	14	(20)
No plan to switch to ISO 9001: 2000	—	0	(0)
Total		68	(100)

^aThe figure in parentheses indicates the percentage of total firms.

Table 3: Applicability of the ISO 9000 standards

Item	Choice	Numbers of firms	
Whether the new standard has better applicability?	Disagree	4	(6) ^a
	Agree	60	(88)
	No difference	4	(6)
	Total	68	(100)
If agree, the reason is that	The new standard is of simplicity	6	(10)
	The new standard is of flexibility	41	(68)
	The new standard is of compatibility	10	(17)
	Others	3	(5)
	Total	60	(100)
Is there any changes of paper work in transferring from 1994 to 2000 version?	Increase	4	(6)
	Decrease	52	(76)
	No changes	6	(9)
	Others	6	(9)
	Total	68	(100)

^aThe figure in parentheses indicates the percentage of total firms.

finished transferring from ISO 9000:1994 to 2000 version, 16 per cent have implementing the new standard. Additionally, 20 per cent were on the way transferring to the new standard. This indicates that all firms had some knowledge of the new standard that asks for reviewing, restructuring and extending the existing quality system document, e.g. the quality manual, procedures and work instructions, but also higher levels of management awareness and active participation in the quality system.

Results and Analysis

Applicability of 1994 and 2000 versions of ISO 9000

In the survey, firms were asked to evaluate the applicability of the ISO standard in construction with the results summarized in Table 3.

In Table 3, 88 per cent of respondents opined that the new standard offers better applicability than the old version. There have been records of support and opposition in applying ISO 9000:1994 to construction. Those supported believed that the standards could be applied successfully in construction (Chini and Valdez, 2003; Love and Li, 2000). Some strongly criticized the system by stating that the unique characteristics of the construction industry could generate problems (Anitfos, 1996; Chung, 1999). ISO 9000:1994 was characterized as a documented quality system, in which the documentation procedures were defined by the 20 clauses (Bubshait and Al-Atiq, 1999; Yates and Anitfos, 1997). However, some clauses are not easy to implement as construction activities are discontinuous, dispersed, diverse and distinct, i.e. the four 'D's as described by Tay (1994). According to Zeng *et al.* (2002), these clauses include: corrective and preventive action (4.14), statistical techniques (4.20), and (5) document and data control (4.5).

Out of those who stated better applicability of the new standard, 68 per cent ranked flexibility as the major contribution factor. Flexibility of the system is important as construction activities are versatile. The former ISO 9000:1994 gives a very rigid system, as revealed by Lee (1998).

Out of the respondents, 17 per cent and 10 per cent chose compatibility and simplicity of the new standard. Unlike the 1987 and 1994 versions, the latest version of ISO 9000 standards has incorporated many changes. Certified companies can have higher flexibility in integrating the environmental, health and safety standards with the new quality system (Coleman and Douglas, 2003). The combination of the former 3 elements (9001/2/3) into one (9001) has simplified the system (Boulter and Bendell, 2002), resulting in decreasing any artificial complexity in implementing ISO 9000 (Biazzo and Bernardi, 2003). As Wilkinson and

Dale (2002) stated, the characteristics of the new standard include: (1) simplicity, clarity, language, terminology, less paper; (2) integration into one management system; (3) continuous improvement; (4) process orientation; (5) compatibility with other management standards; (6) customer satisfaction; and (7) business orientation.

With regard to any changes in terms of procedural documentation after transferring from 1994 to 2000 versions, 76 per cent of respondents stated that "paper work decreases". "Paper work" was considered one of the most difficult components of the system. The ISO 9000:1994 series, emphasizing 'doing what you have written' and 'writing what you have done',

are characterized as a documented quality system, structured around the twenty clauses (Yates and Anitfos, 1997). Each element needs supports of high volume of procedure documents, work instructions, and quality records, so that 'paper work' is no doubt obviously increased (Mezher and Ramadan, 1999; Chini and Valdez, 2003). Because it involves a lot of extra work, especially on the preparation of documents outlining all activities at the operational level, the system has led to employee resistance, especially site workers at the frontline (Zeng *et al.*, 2002). Under these circumstances, the management system can be easily trapped into a controlled bureaucracy, with limiting effectiveness (Chini and Valdez, 2003).

One of the biggest changes in ISO 9001:2000 is that the new concepts of process approach management are promoted. The process approach management is defined as "the application of a system of processes within an organization, together with the identification and interactions of these processes, and their management" (Biazzo and Bernardi, 2003). This approach is significantly different from ISO 9000:1994; under the new standard, organizations must identify processes within the quality system, including interactions, manage and control them to the compliance with the requirements. This change of the ISO 9001:2000 standard is significant for construction firms. In the construction industry, the final product is produced by activities in a process and the construction process does not follow a production line as the manufacturing industry does but is composed of concurrent activities in a construction site, such as concreting, bar fixing and formwork erecting (Tam *et al.*, 2000b). The documented procedures form the biggest bureaucrat in controlling the processes/activities.

Effects of ISO 9000 certification on quality management

The respondents were asked to evaluate the effects of ISO 9000 certification on quality management in construction. The results are listed in Table 4.

In Table 4, 50 per cent of respondents opined that ISO 9000 certification has no obvious effect on quality improvement. 35 per cent stated that to some extent "yes". Only 9 per cent claimed that the effects were obvious. The findings are comparable with some previous research (Dick, 2000; Quazi *et al.*, 2002; Rao *et al.*, 1997). In investigating 93 enterprises from the service industries in Singapore, construction and manufacturing, Quazi *et al.* (2002) revealed that the ISO certification did not affect quality management practices and quality results of firms. A study conducted

Table 4: Effects of ISO 9000 certification

Item	Choice	Numbers of firms	
Are there any obvious effects on quality improvement?	Obvious effects	6	(9) ^a
	Yes to some extents	24	(35)
	No obvious effects	34	(50)
	Others	4	(6)
	Total	68	(100)
Improvements in other aspects	Internal operations	28	(41)
	Clients relations	12	(18)
	Marketing	22	(32)
	Subcontractor relations	6	(9)
	Others	0	(0)
	Total	68	(100)

^aThe figure in parentheses indicates the percentage of total firms.

by Tam et al. (2000a) in Hong Kong recorded similar results. In studying the construction industry in Hong Kong, Tam et al. (2000a) made a quantitative analysis using the scores of the Performance Assessment Scoring System (PASS) administered by the Hong Kong Housing Authority. They concluded that certification of ISO 9000 had no obvious effect on quality improvement while Anitfos (1996) had recorded similar results.

With respect to the benefits of ISO 9000 certification on other aspects, including internal operations, client’s relations, marketing, and subcontractor relations, 41 per cent of respondents ranked ‘internal operations’ the first. This is due to the fact that ISO 9000 standard supplies a management model, which delineates the responsibility within organizations. A construction firm’s internal operations can improve through the establishment of a quality system designed to standardize and optimize corporate resources (Chung, 1999). Of the respondents, 32 per cent chose “marketing” effects. Many researchers revealed that ISO 9000 certification increased and maintained the organizational market share (Buttle, 1997; Love and Li, 2000). The certification exercise enabled them to bid for tenders from which they were otherwise excluded due to the fact that ISO 9000 has been increasingly becoming a mandatory requirement for bidding public projects in most of the Asian markets.

Obstacles to effective implementation of ISO 9000 standards

In practice, there are some obstacles to effective implementation of ISO 9000 standards. In the survey, the respondents were required to examine the obstacles, with the results summarized in Table 5.

Table 5: Obstacles to effective implementation of ISO 9000 standards

Obstacles to implementing ISO 9000 standards	Numbers of firms	
Firms’ over-expectation on ISO 9000 standards	12	(17) ^a
Firms’ shortsighted goal for “getting certification”	42	(62)
Lack of necessary guidance for certification	8	(12)
Others	6	(9)
Total	68	(100)

^aThe figure in parentheses indicates the percentage of total firms.

In Table 5, 62 per cent of the respondents ranked “firms’ shortsighted goal for getting certification” first. Previous studies revealed that certification of ISO 9001 enabled certified-organizations to improve business opportunities from which they were otherwise excluded (Huang et al., 1999; Chin et al., 2000). In the construction industry, there are various premium schemes for the ISO 9000 certified construction firms in China

(Zeng et al., 2002), Singapore (Kam and Tang, 1997) and Hong Kong (Tam et al., 2000a). For example, a premium score will be added to the certified firm in tendering for building projects of the public sector and construction firms can benefit directly from the ISO 9000 certification that encourages firms to be ISO 9000 certified in order to keep their image and business (Tam et al., 2000a). Under this circumstance, construction firms have dashed for the certification exercise without a genuine aim to improve the quality management system. This explains the aforementioned finding that certification of ISO 9000 has no obvious effect on quality improvement.

Of the respondents, 17 per cent of the respondents chose the factor of “firms’ over-expectation on ISO 9000 standards”. This is attributed to the fact that ISO 9000 series are international standards and there is a misunderstanding for some people in China that any international standard is superior to other quality management methods including TQM. They believed that implementation of the ISO 9000 standard was a panacea for all the problems in quality management. Some construction firms in China propagandize that projects managed under the ISO 9000 international standards can deliver better final products, which have unfortunately misled their customers. Indeed, the ISO 9000 series assures the process rather than the products (Zeng et al., 2002).

Effective Quality Management Systems

Respondents were asked to choose an effective journey to quality improvement. Four choices were indicated: (i) ISO 9000; (ii) TQM (Zeng et al., 2003); (iii) ISO 9000 integrated with TQM; and (iv) Others, such as “6σ”. The results are shown in Figure 1.

Figure 1. Comparison of various quality management systems

From Figure 1, most respondents (57%) chose ‘ISO 9000 integrated with TQM’. ISO 9000 was ranked the second and the percentage is only 22%. In addition, the percentage of TQM is also very low (6%). The finding is similar to the conclusions conducted by Zeng et al. (2002).

The debate regarding the position of ISO 9000 in the quality management process and particularly its relation with TQM was instigated by Oakland and Mortiboys (1991), when they proposed that a quality assurance system was one of the three major components of TQM. By an international survey of 600 companies from 200 countries, Sun (1999) found that implementing ISO 9000 alone did not contribute much to quality improvement. This may be attributed to the fact that the ISO

9000: 1994 only requires corrective and preventive actions, but seems ignoring the importance of continual improvement. At the same time, a small proportion of firms chose TQM, which may be resulted from the fact of the lack of a clear definition, requirements and directions of TQM (Coleman and Douglas, 2003; Mallak *et al.*, 1997).

It may take a long time for TQM to be mature enough to form part of the organizational culture. Although there are some barriers for TQM implementation in construction, the core content of TQM, such as teamwork and continuous improvement should form part of the quality management system. In the new standard, the requirement of continual improvement is embodied. The underlying objective of the continual improvement described in the new standard is to enhance the organizational ability to satisfy their customers (Low and Teo, 2003). Therefore, it may be the reason that the respondents believed 'ISO 9000 integrated with TQM' is the best way for quality management.

Compared with the survey conducted by Zeng *et al.* in 2002 (see Figure 2), it is shown that "ISO 9000 integrated with TQM" is similarly ranked first by the respondents. The proportion choosing "ISO 9000" decreased from 34% in 2002 to 22% of this study. The number choosing "others" obviously increased from 3% to 15%. This coincides with the findings aforementioned, that is, many respondents (50%) opined that ISO 9000 certification has no obvious effect on quality management.

Figure 2. Preference for quality management in construction (Zeng *et al.*, 2002)

Conclusions

There are some important changes in the new version of ISO 9000 standards. These changes may result in some impact and require some adaptation for the current certified organizations. The findings of the survey reveal that the new standard offers better applicability than the old ones, resulting from its higher flexibility. As regards quality improvement, only a small proportion of the certified firms claimed that ISO 9000 certification has obvious improvement. Most certified firms recognized that implementing ISO 9000 alone did not contribute much to quality improvement.

As regards the obstacles to effective implementation of ISO 9000 standards, "firms' shortsighted goal for getting certification" is the main obstacle. Although all the respondents are ISO 9000-certified, ISO 9000 was not considered as the most effective quality management system. Respondents believed "ISO 9000 integrated with TQM" is the best way for quality management. This shows that the Chinese construction firms highly valued continuous quality improvement, which may take a very long time to realize.

References

1. Anitfos, S.C. (1996) International standards: U.S. construction competitiveness. UMI Dissertation Service, Ann Arbor, Mich.
2. Biazzo, S. and Bernardi, G. (2003) Process management practices and quality systems standards: Risks and opportunities of the new ISO 9001 certification. *Business Process Management Journal*, 9(2), 149-169.
3. Boulter, L. and Bendell, T. (2002) How can ISO 9000: 2000 help companies achieve excellence?: What the company think. *Measuring Business Excellence*, 6(2), 37-41.
4. Bubshait, A.A. and Al-Atiq, T.H. (1999) ISO 9000 quality standards in construction. *Journal of Management in Engineering*, ASCE, 15(6), 41-46.
5. Buttle, F. (1997) ISO 9000: marketing motivations and benefits. *International Journal of Quality and Reliability Management*, 14(9), 936-947.
6. Carlsson, M. and Carlsson, D. (1996) Experiences of implementation ISO 9000 in Swedish industry. *International Journal of Quality and Reliability Management*, 13(7), 36-47.
7. Chin, K.W., Poon, G.K.K. and Pun, K.F. (2000) The critical maintenance issues of the ISO 9000 system: Hong Kong manufacturing industries' perspectives. *Work Study*, 49(3), 89-96.
8. Chini, A.R. and Valdez, H.E. (2003) ISO 9000 and the U.S. construction industry. *Journal of Management in Engineering*, ASCE, 19(2), 78-82.
9. Chung, H.W. (1999) *Understanding quality assurance in construction: a practical guide to ISO 9000*. E & F Spon, London.
10. Coleman, S. and Douglas, A. (2003) Where next for ISO 9000 companies? *The TQM Magazine*, 15(2), 88-92.
11. Dick, G.P.M. (2000) ISO 9000 certification benefits, reality or myth. *The TQM Magazine*, 12(6), 365-371.
12. Ebrahimpour, M., Withers, B. E. and Hikmet, N. (1997) Experiences of US- and foreign-owned firms: a new perspective on ISO 9000 implementation. *International Journal of Production Research*, 35(2), 569-576.
13. Henry, E. (2000) Quality management standardization in the French construction industry: singularities and internationalization prospects. *Construction Management and Economics*, 18(6), 667-677.
14. Huarng, F., Horng, C. and Chen, C. (1999) A study of ISO 9000 process, motivation and performance. *Total Quality Management*, 10(7), 1009-1025.
15. Kam, C.W. and Tang, S.L. (1997) Development and implementation of quality assurance in public construction works in Singapore and Hong Kong. *International Journal of Quality and Reliability Management*, 14(9), 909-928.
16. Karapetrovic, S. (1999) ISO 9000: the system emerging from the vicious circle of compliance. *The TQM Magazine*, 11(2), 111-120.
17. Landin, A. and Nilsson, C. (1999) Do quality systems really make a difference? *Building Research and Information*, 29 (1), 12 - 20.
18. Lee, T.Y. (1998) The development of ISO 9000 certification and the future of quality management. *International Journal of Quality*

- and Reliability Management*, 15(2), 162-177.
19. Love, P.E.D. and Li, H. (2000) Overcoming the problems associated with quality certification. *Construction Management and Economics*, 18(2), 139-149.
 20. Low, S.P. and Fong, E.T.W. (2002) Preparations for ISO 9001:2000 – a study of ISO 9000: 1994 certified construction firms. *Construction Management and Economics*, 20(5), 403-413.
 21. Low, S.P. and Teo, J.A. (2003) Implementing total quality management in construction through ISO 9001:2000. *Architectural Science Review*, 46(2), 159-166.
 22. Mallak, L.A., Bringelson, L.S. and Lyth, D.M. (1997) A cultural study of ISO 9000 certification. *International Journal of Quality and Reliability Management*, 14(4), 328-348.
 23. Mezher, T. and Ramadan, H. (1999) The costs and benefits of getting the ISO 9000 certification in the manufacturing sector in Saudi Arabia. *Quality Assurance: Good Practice, Regulation, and Law*, 6(2), 107-122.
 24. Oakland, J. and Mortiboys, R. (1991) *Total Quality Management and Effective Leadership*. Department of Trade and Industry, London.
 25. Quazi, H.A., Chang, W.H. and Chan, T.M. (2002) Impact of ISO 9000 certification on quality management practices: A comparative study. *Total Quality Management*, 13(1), 53-67.
 26. Ramin, M., Ali, R.G. and Seiichi, K. (1999) ISO 9000 standards: perceptions and experiences in the UK construction industry. *Construction Management and Economics*, 17(1), 107-119.
 27. Rao, S.S., Ragu-Nathan, T.S. and Soils, L.E. (1997) Does ISO 9000 have an effect on quality management practices? An international empirical study. *Total Quality Management*, 8(6), 335-346.
 28. Sun, H. (1999) The patterns of implementing TQM versus ISO 9000 at the beginning of the 1990s'. *International Journal of Quality and Reliability Management*, 16(3), 201-215.
 29. Tam, C.M., Deng, Z.M., Zeng, S.X. and Ho, C.S. (2000a) Quest for continuous quality improvement for public housing construction in Hong Kong. *Construction Management and Economics*, 18(4), 437-446.
 30. Tam, C.M., Deng, Z.M., Zeng, S.X. and Ho, C.S. (2000b) Performance assessment scoring system of public housing construction for quality improvement in Hong Kong. *International Journal of Quality and Reliability Management*, 17(4/5), 467-478.
 31. Tay, H.P. (1994) Putting quality in place for the construction industry. *Proceedings of 25th Anniversary Seminar: The Impact of Regionalism on Building and Estate Management Professional*, National University of Singapore, Singapore, 1-16.
 32. Terziovski, M., Samson, D. and Dow, D. (1997) The business value of quality management system certification: evidence from Australia and New Zealand. *Journal of Operations Management*, 15(1), 1-18.
 33. Terziovski, M., Power, D. and Sohal, A.S. (2003) The longitudinal effects of the ISO 9000 certification process on business performance. *European Journal of Operational Research*, 146(3), 580-595.
 34. Tsim, Y.C., Yeung, V.W.S. and Leung, E.T.C. (2002) An adaptation to ISO 9001: 2000 for certified organizations. *Managerial Auditing Journal*, 17(5), 245-250.
 35. Wilkinson, G. and Dale, B.G. (2002) An examination of the ISO 9001: 2000 standard and its influence on the integration of management systems. *Production Planning and Control*, 13(3), 284-297.
 36. Yates, J.K. and Anifto, S. (1997) International standards and construction. *Journal of Construction Engineering and Management*, ASCE, 123(2), 127-137.
 37. Yeung, A. C. L., Lee, T. S. and Chan, L. Y. (2003) Senior management perspectives and ISO 9000 effectiveness: an empirical research. *International Journal of Production Research*, 41(3), 545-569.
 38. Zeng, S.X., Tam, C.M., Wang, H.C. and Deng, Z.M. (2002) Quality certification scheme in the construction industry of China. *Architectural Science Review*, 45(2), 83-89.
 39. Zeng, S.X., Tam, C.M., Deng, Z.M. and Wang, H.C. (2003) The rise and fall of total quality management in the Chinese construction industry. *Architectural Science Review*, 46(2), 105-113.