TQM of Engineering Survey Operations under ISO 9001 in Hong Kong

Steve Y. W. LAM, People's Republic of China

Key words: Total quality management, engineering surveying, ISO 9001, construction

SUMMARY

The urgent need to achieve high accuracy standards and productivity in engineering surveying necessitates survey management system to be improved and to integrate the system with the recent release of ISO 9001(2008) for construction projects in Hong Kong. This paper explains the total quality management (TQM) system for managing engineering survey operations, that is, geodetic control, detail mapping, geometric modelling, setting-out, as-built surveys and deformation monitoring surveys, according to ISO 9001 criteria of Quality Management System, Management Responsibility, Resource Management, Product Realization, and Measurement, Analysis and Improvement.

Under the requirements of "Quality Management System", the organization must document the Quality Plans, Quality Manuals, Project Quality Plan, Outsource Plan, Survey Quality Plan, Work Instruction and Quality Control Records for use by board of directors, managers, supervisors, and technical and clerical staff to achieve the quality objectives. Under the requirements of "Management Responsibility" and "Resource Management", surveyors must ensure the availability of human and financial resources and are responsible to meet consumer expectations according to individuals' job description, survey standards, code of practice and Work Instruction. Under the requirements of "Product Realization", surveyors perform the survey operations according to the quality objectives and requirements of the survey operations, carry out inspection and testing activities to the criteria for acceptance, and provide evidence that the realization processes and resulting services meet requirements. Under the requirements of "Measurement, Analysis and Improvement", methods are given in this paper to monitor and continually improve the survey operations. Notable results in customer satisfaction and cost saving are reported by surveyors after implementing the TQM model.

TQM of Engineering Survey Operations under ISO 9001 in Hong Kong

Steve Y. W. LAM, People's Republic of China

1. INTRODUCTION

Contemporary business management and organizational theories have evolved from the rational systems of scientific management and organizational goals (1900-1930) through the natural systems of individual needs and human relations (1930-1960) to the open systems of interdependence, integration, contingencies, standards and total quality management under the influences of the social, economic, political and global environment (1960-present) (Crainer, 2003; Hoy and Miskel, 2008, Table 1.2). Total quality management (TQM) is defined as both a quality management philosophy and a set of guiding principles that foster an organizational culture and participation of all members of the organization aiming at long-term success through customer satisfaction and continuous improvement of products and services, and at benefits for all the members of society (Juran et al., 1999; Rampersad, 2001; Besterfield et al., 2003). Various nations and regional organizations have established quality awards and standards to provide guidelines for applying TQM in practice. The most widely known of these awards are the Deming Prize in Japan, the Malcolm Baldrige National Quality Award in the United States, and the European Quality Award.

Since 1990s, the ISO 9000 series of standards have been published by the International Organization for Standardization (ISO). Many researchers have pointed out that ISO 9000 is the stepping stone to TQM towards business excellence (e.g., Quazi and Padibjo, 1997; Mann and Voss, 2000). While retaining the requirements of third-party assessment and registration, the requirements of the standards are well defined and easier to implement than the less definite and non-specific requirements of TQM philosophy, and provide guidelines and a foundation for TQM systems and programmes in pursuit of the aforementioned TQM awards.

In Hong Kong, most construction and survey firms are seeking ISO 9001 certification so as to become eligible for tendering for government or international projects. Short-term benefits of ISO 9000 certification include advertising needs, satisfying customers, and competitive advantages (Gotzamani and Tsiotras, 2002). Long-term advantages include long-term relationship with external customers and suppliers, satisfying internal customers and TQM process, and continual improvements of products. A list of 20 possible long-term benefits of the certification is given in (Gotzamani and Tsiotras, 2002).

This paper provides a fundamental, yet comprehensive coverage of the TQM system for managing engineering survey operations (Figure 1) according to the ISO 9001 criteria of Quality Management System, Management Responsibility, Resource Management, Product Realization, and Measurement, Analysis and Improvement (Figure 2). The engineering survey operations, a branch of land surveying or geomatics engineering, include geodetic

control, detail mapping, geometric modelling, setting-out for construction, as-built record surveys, deformation monitoring surveys and TQM of the aforementioned operations.

2. QUALITY MANAGEMENT SYSTEM

Under the ISO 9001 criteria (Figure 2), the organization shall determine the processes needed for the Quality Management System (QMS) and document the processes in five levels of quality control documents (Lam and Tang, 2002):

(1) Quality Plans for board of directors and top management containing statements of missions, core values, quality policies and quality objectives, which are integrated with the company's strategic management plans (i.e., Business Plan, Financial Plan, Marketing Plan, Human Resources Management Plan, and Knowledge/IT Management Plan).
(2) Quality Procedure Manuals for project directors and managers containing the scope, exclusions, operating procedures and interacting processes of the QMS.
(3) Department/Section Manuals for managers and supervisors
(4) Work/Operation Instruction for supervisors, technical staff and clerical staff.
(5) Quality Control Records which must be legible, traceable and easy to retrieve.

Since different construction projects may have different contract requirements and customer expectation, Project Quality Plans (PQP), Outsource Plan (OP), Survey Quality Plans (SQP), and other site quality plans may be required as supplement to the company's Quality Manuals. A SQP for construction project usually has the following documents (Lam and Tang, 2002):

(1) Job description and responsibilities of all survey personnel (chief surveyor, senior surveyor, surveyor, survey assistant, etc.) in the project together with a Survey Organization Chart.
(2) Method Statements for integrating SQP with related quality plans.
(3) Method statements for establishing, maintaining and recording survey data.
(4) Survey Inspection Plan.
(5) Method statements for surveying different structures of the construction.
(6) Survey specifications and allowable tolerances.
(7) Inspection and Testing Plan (ITP) for geodetic control, detail mapping, geometric modelling, setting-out, as-built surveys, monitoring surveys and TQM of the survey operations.
(8) ITP for testing and calibration of survey instrument.
(9) Work Instructions (WI) for methods and procedures of the survey operations including testing and calibration of survey instruments.

OP is new to ISO 9001, which contains outsourcing or subcontracting items in an attempt to reduce costs and improve performance. Items include a checklist for Choice of Subcontractors (e.g., subcontractor's experience, staffing, financial standing and competitive price) and a checklist for the Standard Forms and Clauses of Subcontract.

3. MANAGEMENT RESPONSIBILITY AND RESOURCE MANAGEMENT

Under the requirements of ”Management Responsibility” and “Resource Management”, the chief surveyor has to control human, material and financial resources provided by the human resources department of the organization. It is the responsibility of the chief surveyor to establish responsibility charts for each project to define:

(1) The organizational structure of survey teams.
(2) The necessary human resources policies and procedures to enable the survey organization to achieve its objectives.
(3) Job description and responsibility of named survey workers and subcontractors to achieve a particular milestone.

It is the responsibility of the chief surveyor to evaluate and select survey staffs, suppliers of survey materials and equipment, and survey sub-contractors. Special attention shall be made to foresee their technical capabilities and resources to execute the proposed work within the time frame and survey budget of the project. In construction projects, it is the responsibility of each individual surveyor to perform:

(1) Establishment of vertical and horizontal control points on site.
(2) Setting-out of structural elements, formwork and guidance machines for construction.
(3) Monitoring of settlement and deformation of existing structures for the safety of construction workers and the public.
(4) Preparation of detail plans and as-built drawings for design and dimensional control of the product.
(5) Liaison with clients (developer, consultants, engineers or the public) for any setting-out discrepancies or boundary disputes.
(6) Checking and calibration of surveying instruments.
(7) Training of junior surveyors and assistants.
(8) Proper personnel management and administration of the project on site.

4. PRODUCT REALIZATION

Under the requirements of “Product Realisation”, the survey operations must be carried out under controlled conditions. Controlled conditions comprise:

(1) Approved method statement for the construction process including surveying.
(2) Use of suitable material and equipment.
(3) Safe working environment.
(4) Compliance with the reference standards, codes of practice, PQP, design drawings and other specifications.
(5) Monitoring and control of construction stages in accordance with ITPs (Inspection and Testing Plans) for surveying and construction.

ISO 9001 specifies that all measuring and test equipment, whether owned by the company, on rental or provided by the customers, must be controlled, calibrated and maintained. This is to ensure that all measurements are consistent with the accuracy and precision required of the job. Test certificates and calibration of survey instruments and other inspection equipment

must be traceable to national or international standards, and in accordance with documented procedures. Documented procedures are:
(1) ITP for testing and calibration of survey instrument.
(2) WI for methods and procedures of testing and calibration of survey instruments. Methods and procedures for checking levels, total stations and other surveying instruments are published in ISO 17123: Parts 1 through 8.
(3) Schedules and records of calibration.

5. MEASUREMENT, ANALYSIS AND IMPROVEMENT

Under the requirements of ”Measurement, Analysis and Improvement”, a quality monitoring system should be maintained by internal quality audits, management reviews and feed backs from quality training programs. In surveying operations, practices will be reviewed by the chief surveyor or the quality controller of the project at regular intervals. The audit will evaluate selected survey jobs according to the following guidelines:
(1) Suitability of data and documents for the intended purpose.
(2) Adherence to instructions, method statements, specifications and standards.
(3) Proper application of surveying methods and procedures.
(4) Completeness, correctness and clarity of field notes, measurements, computations, plans and other survey documents.

Any deficiency found by the audit should be recorded and brought to the person who is responsible for the problem, to carry out corrective action with preventive measures for future operations. Any non-conformance which does not fulfill contractual requirements should be identified and reported to the Quality Control Manager and the Project Manager. Department heads should record all incidents of failure and segregate any item or area of work at fault in order to enable other work to proceed with minimum interruptions. All non-conforming materials and workmanship shall be reviewed by authorized personnel in accordance with documented procedures so that decisions can be made to carry-out corrective action and to prevent recurrence. The following alternatives are considered for corrective action:
(1) Rework to meet specified requirement. In this case, remedial work is required.
(2) Revise the design and adopt existing product.
(3) Accept under concession from the client.
(4) Reject and be replaced by a new product.

6. CONCLUSIONS

This paper explains briefly the engineering survey operations (Figure 1) and how to manage the operations under the TQM criteria of ISO 9001 (Figure 2) currently adopted by construction projects in Hong Kong. Notable results in customer satisfaction and cost saving are reported by surveyors after implementing the TQM model. The quality management system has helped survey firms to focus on their goals and operations. Under the standards, good relationships between contractors and clients are established by having well-defined and mutually agreed requirements for the product and service. Based on documented procedure and instruction of the quality system, every worker has a clear understanding of his/ her duty.

There will not be a situation where a surveyor leaves and the whole system collapses because no body can do his/ her work. The job will be taken over by other worker and production will continue as usual according to Work Procedures, Work Instructions and job description published by the company. Under the management system, cautious and preventive attitudes will be developed throughout the organisation. More innovative and efficient technology will be initiated and adopted by the quality system to reduce cost of materials, labour wages and time for the production. Thus, the system results in better quality of work, more efficient allocation of resources, less wastage of materials, and better site safety. Nevertheless, bureaucracy may occur due to increased paper work from the documented procedures and signed reports, and the cost of regular audits and achieving registration are considered expensive to small contractors. As an integral part of construction or survey business, ISO standards adopted by construction and other industrial sectors will continue to grow. Whoever is able to supply better quality products at lower cost will capture more market share. And the TQM under ISO standards is the international tool in pursuit of such excellence and profitability in both the surveying and construction industries.

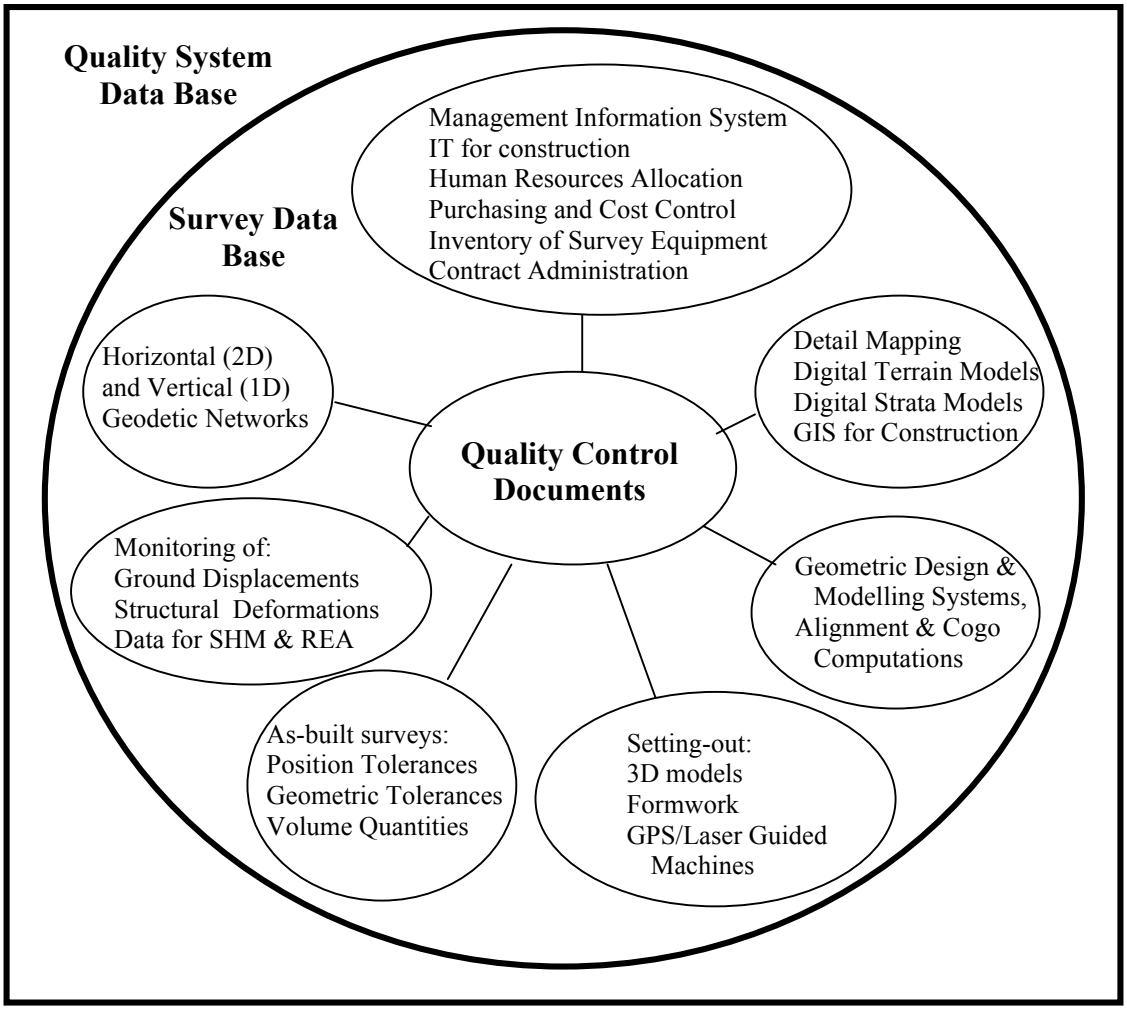

Figure 1: Engineering survey operations and database for construction projects (Lam and Tang, 2002, 2004; Lam, 2005).

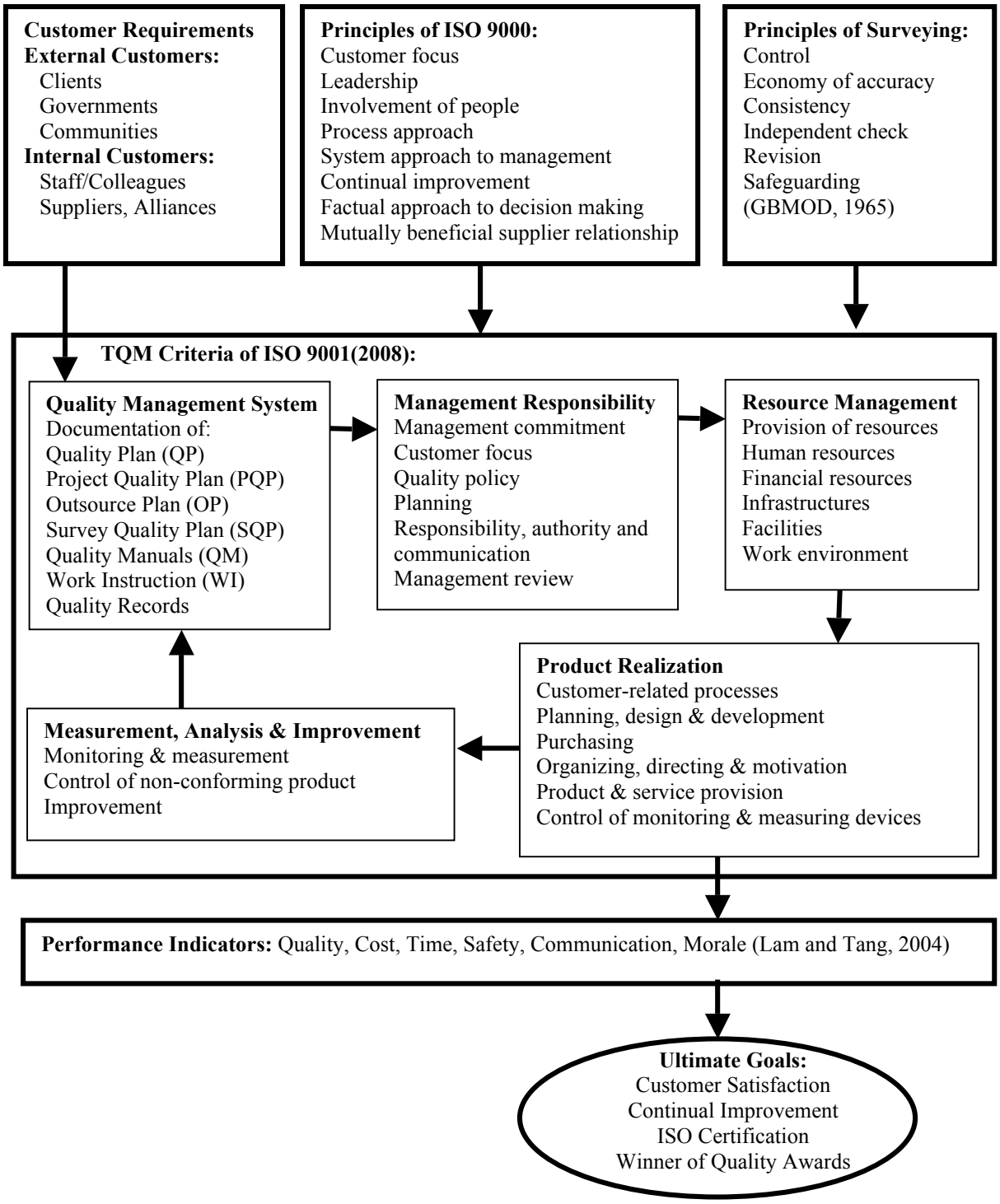

Figure 2: TQM framework for engineering survey operations under ISO 9001.

REFERENCES

Besterfield, D., Besterfield-Michna, C., Nesterfield, G. and Besterfirld-Sccre, M. (2003). *Total Quality Management*, 3rd Edition. New Jersey: Prentice Hall.

Crainer, S. (2003). *The Ultimate Business Library: The Greatest Books That Made Management*. Oxford: Capstone Publishing Ltd.

GBMOD (1965). *Textbook of Topographical Surveying,* 4th ed. Great Britain Ministry of Defence. London: HMSO.

Gotzamani, K. and Tsiotras, G. (2002). The True Motives Behind ISO 9000 Certification – Their Effect on the Overall Certification and Benefits and Long-term Contribution Towards TQM. *International Journal of Quality and Reliability Management*, Vol. 19, No. 2, pp. 151-169.

Hoy, W. K. and Miskel, C. G. (2008). *Educational Administration: Theory, Research and Practice,* 8th ed. New York: McGraw-Hill Higher Education.

ISO 9000 (2005). *Quality Management Systems – Fundamentals and Vocabulary.* Geneva: International Organization for Standardization.

ISO 9001 (2008). *Quality Management Systems – Requirements.* Geneva: International Organization for Standardization.

ISO 17123 (2001). *Optics and Optical Instruments – Field Procedures for Testing Geodetic and Surveying Instruments – Parts 1 through 8.* Geneva: International Organization for Standardization.

Juran, J. and Godfrey, A. (eds.) (1999). *Juran's Quality Handbook,* 5th edition. New York: McGraw-Hill.

Lam, S. (2005). *Engineering Surveying for Civil Engineers: An Algorithmic Approach*. Singapore: McGraw-Hill Education.

Lam, S. and Tang, C. (2002). Role of Surveyors under ISO 9000 in the Construction Industry. *Journal of Surveying Engineering*, Vol. 128, No. 4, pp. 187-199, ASCE.

Lam, S. and Tang, C. (2004). A TQM Model for Construction Surveying Under ISO 9000. *Geomatica*, Vol. 58, No. 3, pp. 195-202, CIG.

Mann, R. and Voss, M. (2000). An Innovative Process Improvement Approach That Integrates ISO 9000 with the Baldrige Framework. *Benchmarking: an International Journal*, Vol. 7, No. 2, pp. 128-145.

Quazi, H. and Padibjo, S. (1997). Journey Towards Total Quality Management Through ISO 9000 Certification – A Singapore Experience. *TQM Magazine*, Vol. 9, No. 5, pp. 364-371.

Rampersad, H. (2001). *Total Quality Management: an Executive Guide to Continuous Improvement.* New York: Springer.

BIOGRAPHICAL NOTES

Steve Lam, *BTech, BA, MPhil, MSc, MEd, Canada Lands Surveyor (CLS), FICE, MRICS, MCIOB,* is currently Lecturer in the Department of Land Surveying and Geo-Informatics at The Hong Kong Polytechnic University. Before joining the University, he was Site Agent and Chief Land Surveyor in land surveying and construction projects.

CONTACTS

Mr. Steve Y. W. Lam
The Hong Kong Polytechnic University
Department of Land Surveying and Geo-Informatics
Hung Hom, Kowloon,
Hong Kong SAR
People's Republic of China
Tel. + (852) 2766 5964
Fax + (852) 2330 2994
Email: lslams@polyu.edu.hk