

**Zeitschrift:** IABSE reports = Rapports AIPC = IVBH Berichte  
**Band:** 50 (1986)

**Artikel:** Human and organizational aspects of quality assurance in Japanese construction firms  
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**DOI:** <https://doi.org/10.5169/seals-39129>

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## **Human and Organizational Aspects of Quality Assurance in Japanese Construction Firms**

Aspects humains et d'organisation d'assurance de la qualité dans les entreprises de construction au Japon

Menschliche und organisatorische Aspekte der Qualitätssicherung  
in japanischen Unternehmungen

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### **SUMMARY**

This paper presents a general overview of the human and organizational aspects of Quality Control activities which are widely practiced among major construction firms in Japan, focusing especially on Quality Assurance systems. Characteristics of Japanese-style Quality Control from the viewpoint of management principles are introduced. A representative example of QA activities is presented. The future of Quality Control in the construction firms is briefly touched upon.

### **RÉSUMÉ**

L'article présente une vue générale des aspects humains et d'organisation dans le contrôle de la qualité, pratiqué dans les principales entreprises de construction au Japon. Il mentionne en particulier les systèmes d'assurance de la qualité. Les caractéristiques du contrôle japonais de la qualité sont soulignées, et un exemple typique est présenté. L'avenir du contrôle de la qualité dans les entreprises de construction est brièvement esquissé.

### **ZUSAMMENFASSUNG**

Der Beitrag gibt einen generellen Überblick über menschliche und organisatorische Aspekte der Qualitätskontrolle, wie sie in grösseren japanischen Unternehmungen praktiziert wird und geht dabei insbesondere auf Qualitäts-Sicherungs-Systeme ein. Typisch japanische Management-Prinzipien der Qualitätskontrolle werden dargestellt und die Tendenzen in Unternehmungen kurz besprochen.



## 1. INTRODUCTION

Demand for assuring the quality of civil and building works is increasing throughout the world. Without doubt, great advances have been seen in engineering and construction technology in recent years, but the quality of works is not necessarily assured by the superiority of technology alone, because it is people and organizations that command the technology. How the behavior of humans and the setup of organizations are related to the quality Assurance (QA) is a very interesting and important topic.

## 2. FUNDAMENTALS OF QUALITY MANAGEMENT

### 2.1. Quality Management and CWQC (or TQC)

In the Japanese Industrial Standards (JIS), it is defined that, in order to efficiently implement the Quality Control (QC), the entire company, including top executives, managers, superintendents, foremen and workers, must be involved and cooperate in the efforts of improving quality, and QC activities must be applied to all stages of the firm's operation, including market research, R and D, product planning, design and engineering, production installations, procurement, sub-contracting, production, inspection, marketing, and after-sales services as well as financial, administrative and educational matters. The QC implemented in such a philosophy is "Company Wide Quality Control (CWQC) or Total Quality Control (TQC).

Managers of leading industries of Japan have, without exception, incorporated QC systems into their corporate organizations and a great majority of them are based on the philosophy of CWQC as described above. Further, many leading industries of Japan place "Quality" in the axis of their management policy.

### 2.2. Characteristics of the Organizational Aspects of Japanese-Style Quality Control

#### (1) Nation-wide QC Promotion Organization

There exists a nation-wide QC Promotion organization with a membership of private firms covering a wide range of industries, not only manufacturing industries but non-manufacturing business firms such as banks, trading houses, utility companies, department stores and etc. The organization dispatches expert instructors on CWQC to whatever companies are interested in QC, conducts a variety of QC-related gatherings such as seminars and symposiums throughout the country. Through this organization of QC promotion, a firm can acquire an extensive knowledge about CWQC not only from other firms in the same line of business but from any other type of industry.

#### (2) Company-wide QC Promotion Activities

The most noteworthy point is that in Japanese firms QC is not under the sole responsibility of a QC department or QC specialists but that every member of the firm, from an extreme top executive to a worker at a workplace is required to contribute to quality assurance by controlling and improving the quality of the works to which he or she is assigned.

In many cases, subcontractors and their workers participate in QC activities.

### (3) Top executives always lead QC promotion

In CWQC of a Japanese company, top executives including a president, executive vice presidents and managing directors must always lead the promotion of the company's QC. Top executives and department managers regularly conduct so-called "QC diagnosis", which is intended to examine whether or not QC systems of the company or departments are functioning satisfactorily.

## 2.3 Characteristics of the Human Aspects of Japanese-style Quality Control

### (1) QC education and training to every one from the top to the bottom.

The management of Japanese industry basically believes that it is people who support and raise the level of management and, therefore, the fostering of human talent is of high importance. For the promotion of CWQC, education and training are given to all members at every echelon of the company from executive level down to the work force level.

### (2) QC Circles everywhere in the company.

QC circle activities are carried out everywhere within the company organization to fully elicit the abilities of people employed at workplaces and to allow their self-realization. This facilitates the willing participation of the employees in product improvement and enhancement of the atmosphere of the workplace.

## 3. CWQC IN THE CONSTRUCTION INDUSTRY

### 3.1. History of CWQC in the Construction Industry

QC in Japan was initiated by a group of young advocates soon after the World War II with a belief that restoration of Japanese economy would only be achieved by improving the quality of Japanese industrial products. By early 1960, many of the leading manufacturing industries of Japan joined the CWQC Campaign as led by the advocates and consequently succeeded in building up their quality reputation in the international market. The construction industries of Japan, until the first oil crisis of 1974, had been favored by such vigorous demands inside the homeland because of reconstruction of war-damaged country as well as rapid development in industry that it was not necessary for them to pay such a degree of attention to CWQC as the manufacturing industries. The two periods of oil crisis gave a dramatic impact to the Japanese economy and the construction industries were also adversely affected. They were waken up to realize that they would not be able to survive unless something was done for rationalization of the constitution of their company. Some of them initiated "Zero Defects" campaigns, while others began to seek other ways of improving their operation. And now, the majority of leading Japanese construction firms are members of the aforementioned nation-wide QC organization.



### 3.2. Organizational Aspects of Quality Assurance in Japanese Construction Company - A Typical Example

This paper will introduce one of the leading construction companies of Japan now implementing Quality Assurance. For readers' reference, indices of the company's business are as follows:

-Established in 1739  
 -Turnover in 1984 approx. 3,700 million USD, of which 35% in design and build type contract  
 -Number of employees (excluding laborers)  
     15,000, (1) of which approximately 75% are in scientific and/or engineering categories  
     (2) of which  
         1,200 in Design/Engineering  
         500 in Research/Development

#### 3.2.1. Basic Policy of Quality Assurance (QA)

It is explicitly stated in the company's basic policy: "to allow our clients to award contacts with confidence and trust, the quality of the products and services we offer must be assured so as to satisfy the clients over the long term." This means that not only the physical quality of structures we build but all the related services we offer from the very beginning of business development activity to the post-turnover services must be met by the customers' satisfaction.

#### 3.2.2. System of Quality Assurance

As an example, the flow of QA activities in case of "Design-and-Build" type contract is as follows:

(1) The QA activities are divided into following 5 stages and 13 steps:

<u>Stage</u>	
S1 Corporate Quality Planning	Q1 Market research and R/D planning
S2 Project Planning/Design	Q2 Business Promotion Q3 Conceptual Plan Q4 Basic Design Q5 Detail Design Q6 Estimation of Cost Q7 Construction Contract
S3 Construction	Q8 Pre-construction Planning Q9 Execution of Construction Q10 Turnover Inspection
S4 Post-turnover Services	Q11 Post-turnover Inspection Q12 Remedial works if needed
S5 Quality Audit	Q13 In-house Evaluation of Quality

(2) Stage S1 (step Q1) is related to overall corporate policy of determining major subjects of Research and Development to be implemented on short, mid and long-term, based upon market research, while stages S1 to S5 (Steps Q2 to Q13) are applicable to a specific project.

(3) At Step Q2 "Business Promotion", thorough discussions are carried out among the client, company's personnel responsible for business development and Design/Engineering Division with regard to "Quality requirement", and then a detailed chart of "Important Quality characteristics to be assured" is agreed upon.

(4) For each of the following steps from Q3 to Q12, 5W+1H (Why, What, Where, Who, When and How) are clearly defined, and inter-departmental linkage is specified.

(5) During Stage S2 "Project Planning/Design", three periods of "Design Review Meeting" are held, each between Q3/Q4, Q4/Q5 and Q5/Q6. The first one must be attended by the personnel responsible for the business development and the last one by the construction manager assigned to the projects.

	<u>Design Review Mtg</u>	<u>Objective</u>
DR-I		to check whether or not quality requirement of the client and given external conditions of construction are fully taken into the design concept
DR-II		to check whether or not technical specifications are in complete compliance with result of DR-I and methods of construction are suitably taken into the design
DR-III		to finally check the design from technical and economical feasibility, as well as from legalistic viewpoints

(6) At Step Q8, beginning of Stage S3, the Pre-construction Committee Meeting is held with attendance by representatives of QA Department, Research Laboratory, Design/Engineering Division, Labor and Safety Department, Audit Department, Construction Equipment Department, Procurement Department and, if necessary, Legal Department. Prior to this committee meeting, the Construction Manager of the Project must prepare the "Construction Execution Plan" and "Working Budget Plan" for check-and-review by the committee members, and at the meeting he must make verbal presentation, answer all the questions given by the committee and, if necessary, amend his plan for approval by the committee. This is one of the most important events in the QA procedure.

(7) A rule of "Information Feedback" is also stipulated by the QA Standards.

FB1	at the end of Step Q5
FB2	" Step Q7
FB3	during Step Q9
FB4	" Step Q10
FB5	" Step Q11
FB6	" Step Q12
FB7	at the end of Step Q13

This information acquired through the entire duration of QA activities is fed back to relevant departments of the company and accumulated for further improvement of QC system of the company.

(8) Final three Steps Q11 to Q13 are unique QA activities being implemented by the company. Step Q11 is two voluntary inspection visits made by QA Department at 6 months and 12 months after turnover to see whether or not the product remains in compliance with conditions of the contract and to hear from the customer how he evaluates the works he has accepted.



### 3.2.3. Quality Control Activities as Fundamentals of Quality Assurance

(1) Needless to say, QC activities are indispensable means of QA. The very basic principle of QC is to continue to rotate the circle of P-D-C-A (Plan-Do-Check-Action), which means to establish a plan on a basis of full understanding and confirmation of required quality, perform the work in strict accordance with the plan, check the result of works performed by using statistical methods as far as is practicable, and should there be any deviation from specified tolerances of quality then pursue possible major causes of error by statistic analyses and get rid of them, and prevent re-occurrence. There must be a prime circle for the entire project and as many sub-circles of P-D-C-A as necessary for every segment of works.

(2) In order to implement a "check" of P-D-C-A circle, there must be a rule to do it. Standards of quality for every item of works must be prepared in advance. 5W+1H (why, what, when, where, who and how) must be clearly specified by "QC Process Schedule".

(3) In civil construction works it is quite normal that unexpected conditions or major change of conditions confront us and therefore, it is necessary for us to modify the designs. Should such changes be of a very significant nature, the construction manager must without hesitation request experts in the head office organization or elsewhere to come to the site immediately to give the necessary advice.

(4) Since people who perform part of the actual works on site are workers furnished by sub-contractors, it is of vital importance for efficient implementation of QC to involve subcontractors and their foremen in QC activities. Therefore, it is essential to form QC circles consisting of subcontractors' foremen. Generally speaking, Japanese sub-contractors are quite co-operative in this respect.

### 3.3. Human Aspects of Quality Assurance in Japanese Construction Company - also an example

#### 3.3.1. Necessity of Consciousness Reformation and the Introduction of CWQC

As aforementioned, major construction companies of Japan were shaken by the dramatic change of business environment caused by the oil crisis, and they had to realize necessity to improve the basic constitution of the Company. Among the major efforts they have tried was the introduction of CWQC. The company taken as an example in this paper determined to do so basing on its firm belief that "superior products will certainly result if the constitution of the company is improved" and "our competitive power and profitability will be strengthened if the company's constitution is stronger."

Specific aims in this regard were "consciousness-raising" and "anchoring scientific management" and "strengthening and expanding the company's strategy on these foundations." The main points of consciousness raising were "the correct attitude toward problems based on the self-realization of responsibility," "improvement in morals, morale, and motivation" and "an open system of management through the participation of all employees." The fundamental concept of these points was to emphasize improvement of such human aspects as motivating each individual employee to make the maximum use of his abilities and to raise morale in order to build the foundation of the company's prosperity by thinking from the client's standpoint and fulfilling the client's requirements to the

maximum extent possible.

### 3.3.2. Education and Training

In order to thoroughly communicate the direction of the company to all employees and to effectively and efficiently accomplish the goals in view, educational programs suited to the functions of all employees must be carried out repeatedly. This education is not limited to the acquisition of knowledge such as in schools but refers to the broad, practical, hands-on education that employees acquire in their daily activities. The educational methods, therefore, must not be limited to group education but must include on-the-job training and self-enlightenment and mutual enlightenment through the delegation of work from supervisors to subordinates and QC circles.

The group education program of the company consists of management education, education by occupational skill, and special education. Education by occupational skill is aimed at employees who have been in the company for six years or less. The purpose of this education is to regularly raise knowledge and skills in the various speciality fields. Special education includes study programs abroad, language education, and computer training.

As shown in Figure 1, education related to CWQC is carried out as one link of management education. The object of this education is to ingrain the fundamental management policy in managers. CWQC education is conducted for all members of the company, according to level, from president to ordinary workers in order to spread and actively utilize CWQC concepts and methods. Every year approximately 80 key personnel, selected without regard to occupational specialty, undergo a six month course which includes case studies. This enables them to teach statistical quality control to staff personnel who are developing CWQC in the workplace. This CWQC education is generally conducted using texts developed within the company and by in-house instructors. Depending on the purpose, seminars conducted by outside agencies are also utilized. The managerial education consists of experimental training that focuses on human and conceptual skills. This education is divided into courses for top managers and middle managers and a basic course. In this case, specialist trainers from outside the company are invited and the mainpoints emphasized are the self-realization of managers who are responsible for controlling and improving work, training subordinates, and vitalizing the workplace as well as improving their related management abilities.

QC Circle activities are intended to raise consciousness about problems and the desire for improvement through solving problems immediately confronting employees and enhancing abilities through self and mutual enlightenment. The QC circle activities are promoted with the goal of creating a worthy and bright workplace. By vigorously pursuing these activities, substantial results are obtained in improving QCDS. As an example, the details of the 1,096 themes solved from 1981 to 1983 by the QC circles of sub-contractors of the company show that 31 percent involved quality, 29 percent cost, 12 percent delivery, 9 percent safety, and 19 percent other problems.

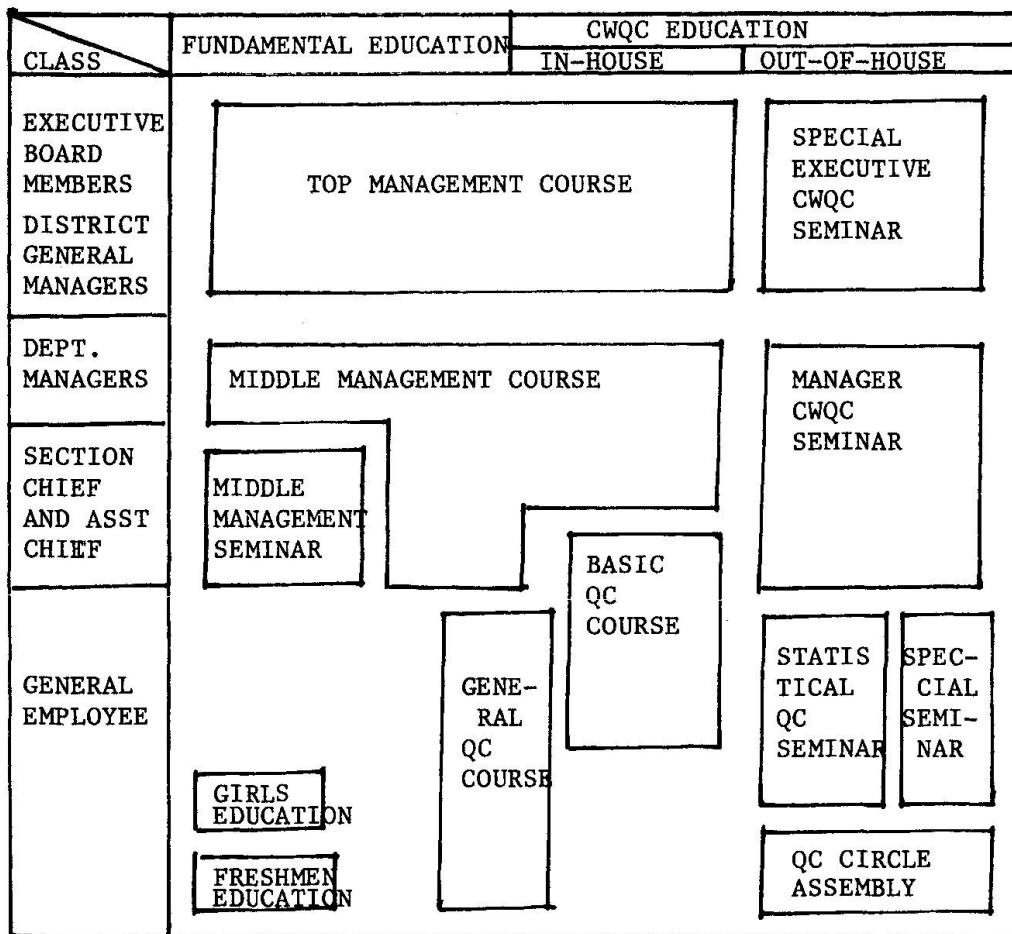


FIG (1)  
EDUCATION AND TRAINING SYSTEM  
OF  
KAJIMA CORPORATION

The QC circles organize the employees most closely involved with the workplace. At construction sites QC circles are frequently organized jointly by and between the company employees and subcontractors' employees. Generally, in the construction industry, since the site changes with each job, personnel structures are fluid, and employees are organized into teams according to specialized abilities, it is difficult to employ methods such as those used in the manufacturing industries, and work must be accomplished utilizing original methods.

### 3.3.3. Improving the Workplace Atmosphere

Recognizing the fact that human behavior is not only influenced by the individual personality but is also strongly affected by the environment in which the individual is placed, the company is making concerted efforts to improve the atmosphere of the workplace.

#### (1) Workplace Vitalization

At the company, workplace vitalization is defined as "changing the atmosphere of the workplace so that each individual employee understands the company's policy as his own and enthusiastically approaches his work while using his individuality and abilities to the utmost so that all members together can achieve the goals of the organization."

Workplace vitalization is pursued in the course of executing work and is the responsibility of the construction manager at the workplace. To accomplish this, workplace managers conduct the following activities.

- a) Set and clarify policy based on top management policy, the basic duties of the workplace, the current status, and individual concepts.
- b) Based on a thorough understanding of the policy, fully coordinate all actions of subordinates.
- c) When an improvement in the system is necessary, work actively to implement this improvement.
- d) Display a positive interest, delegate problems to subordinates, and generate action.

#### (2) Adoption of a suggestion system

At the Company, a suggestion system has been set up and not only their own employees but also those of subcontractors are encouraged to report problems they have noticed in their work and to make suggestions for improvements. The purpose of this is not limited to solving problems. By raising the "problem consciousness" and sense of participation of employees and encouraging creative work, a lively workplace can be realized where work is pleasurable and rewarding.

#### (3) Determining the actual atmosphere of the workplace

It is necessary to see how workplace vitalization has been prompted. At the company, Organizational Behavior Surveys (OBSs) are regularly conducted by department and section units and the actual state of the workplace atmosphere is quantitatively measured. Based on this data, problems in each workplace are studied and all employees strive to improve the atmosphere of the workplace.

## 4. PROBLEMS TO BE SOLVED

In the preceding chapters the factors related to the human and organizational aspects of Quality Assurance were surveyed by introducing a typical example of one of the leading construction companies of Japan. These activities reflect less than ten years experiences accumulated by the company and there are



problems that remain to be solved in the future. Among others the following may be mentioned as some examples of problems.

Firstly, the quality requirement of the client who awards contract to the contractor is not necessarily in full agreement with the needs of the end-user.

Secondly, the allocation of responsibilities among the client or the Employer, the Engineer and the contractor is not necessarily clear-cut.

Thirdly, prevention of unsatisfactory quality due to human error is still a big problem particularly in civil and building construction.