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## Quality Assurance – The Japanese Way

Pratique japonaise de l'assurance de la qualité

Zur Art und Weise der Qualitätssicherung in Japan

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### SUMMARY

This paper describes some characteristics of quality assurance activities in Japan and the outline of an example of the company-wide quality assurance activities of a general contractor. It deals with the background of quality assurance activities undertaken by Japanese construction contractors, and highlights some characteristics of quality control in Japan. It shows quality assurance practices among general contractors. Some tasks to be tackled by Japanese contractors in the future are mentioned.

### RÉSUMÉ

La contribution décrit quelques caractéristiques des activités de l'assurance de la qualité au Japon, d'une façon générale et dans le cas d'une grande entreprise de construction. Il traite de l'origine des activités d'assurance de la qualité au Japon et souligne quelques caractéristiques du contrôle de la qualité dans ce pays. Il donne quelques exemples d'assurance de la qualité dans les entreprises générales de construction. Quelques futures tâches à résoudre par les entrepreneurs japonais sont mentionnées.

### ZUSAMMENFASSUNG

Der Beitrag beschreibt einige Merkmale der in Japan praktizierten Qualitätssicherung und erläutert diese am Beispiel einer weltweit tätigen Bauunternehmung. Im ersten Teil werden die Grundlagen beschrieben, der zweite beleuchtet einige allgemeine Merkmale japanischer Qualitäts-Kontrolle, während der dritte sich mit der Übertragung dieser Grundlagen auf Bauunternehmungen befasst. Der letzte Abschnitt beschreibt in aller Kürze die von den Japanischen Unternehmungen in Zukunft zu lösenden Probleme.



## 1. INTRODUCTION

The quality control activities in Japan which originated in the steel and chemical industries have spread to assembly industries such as home appliances, automobiles and precision machinery. They are now further expanding into such industries based on orders from client as construction, and even to enterprises which are mainly engaged in sales and services.

In particular, worthy of special mention is the enthusiasm with which construction firms are now wrestling with quality control.

The reasons for such enthusiasm - so much so that quality control might be said to have become a boom - could be the following.

- a. The fact became widely known that while many Japanese manufacturers acquired the ability to provide high-quality but cheap products through productivity improvement, the reason behind such success was the great efforts spent for quality control.
- b. The oil crises which have occurred twice since 1974 exerted marked influence on Japanese enterprises.

Before the oil crises, the Japanese construction industry, which had a substantial market domestically, did not have to worry about quality control to the same extent as did the manufacturing industry. After the oil crises however, many such enterprises came to recognize, as a natural matter of course, that they had to do something to upgrade their own competitive power through rationalization of management.

Given such circumstances, the writer would like to discuss some of the characteristics of quality control efforts now being made by Japanese construction firms, and in particular, the Quality Assurance activities which form the core of such efforts.

## 2. QUALITY ASSURANCE (QA) ACTIVITIES IN JAPAN

### 2.1 Meaning of the Word "Quality"

A notable characteristic of QA activities in Japanese enterprises is the interpretation of the word "quality". That is, they have pursued "quality which can satisfy the requirements of customers," and extended efforts for its realization.

It was W.A. Shewhart who analyzed the meaning of quality in an industrial field. He pointed out that quality has both an objective/physical side and a subjective side, and that the goodness of a thing is a function of its subjective perception.

Subsequently, however, researchers, including Shewhart himself, carried out studies on statistical quality control as a means of achieving high quality, but on the basis of a definition of quality which was mainly based on objective perception (i.e., the producer's definition).

There were other definitions which sought to change this current of thinking:

- "A product that is maximally useful and has a market" (W.E. Deming)
- "Satisfaction of customer's needs" (J.M. Juran)
- "Products which can satisfy the requirements of consumers" (Kaoru Ishikawa)  
(i.e., the user's definition)

The latter definitions are said to be effective in developing new markets for new products.

## 2.2 Company-Wide QA Activities

Quality assurance activities in Japan are not something carried out only by quality control departments. Nor are they limited in manufacturing departments. They are company-wide activities.

In order to achieve "quality which can satisfy the requirements of customers" as mentioned in 2.1 above, what is needed are company-wide activities: accurate grasping of customer needs (marketing department), conversion of such needs into technological specifications for production (planning and designing departments), production based on design (production department), and maintenance and after-sale services (service department).

In order to systematically carry out these activities, the roles of various department and the method of implementation are determined, and consolidated into a System of Quality Assurance.

## 2.3 Quality Control (QC) Circle Activities

QC circle activities are contributing toward quality improvement.

Quality improvement is not the sole responsibility of QC specialists. QC circles, which are made up of production line workers, also share that responsibility. This is based on the belief that workers who are actually working in the workshops should know best about troubles on the production line, and that such knowledge should be utilized for quality improvement.



Part of the reason also is that having workers participate in such efforts will motivate them to work and provide a place for education and training.

Today, QC circle activities are playing an important role in improving quality, but the key point in all of this activity is to respect the initiative of the participants. We should understand that they originated as members' study groups, and as they gained more in capability, they were able to achieve good results in making quality improvements. For if we expect quick results in quality improvement from the outset, there is a possibility that activities may fail.

### 3. TYPICAL EXAMPLE IN STRUCTURAL ENGINEERING AND CONSTRUCTION

The writer will elaborate, using a practical example, on how the aforementioned "quality assurance activities in Japan" can actually be applied in the field of structural engineering and construction.

#### 3.1 Typical Steps of Quality Assurance in Structural Engineering and Construction

More often than not, Japanese major contractors are possessed of in-house integrated capacities regarding R & D, design and engineering, and construction. Accordingly, when a project is awarded to such a major contractor, Q.A. will be implemented under single responsibility.

In one typical major contractor of Japan, Quality Assurance activities for a design-and-build type contract are classified into steps as described below:

##### Step 1.

- (1) Preparation of "Quality Requirement Chart", by which qualities of the subject to design-and-build are developed from general requirements the Client to specific and concrete objectives of quality to be assured.
- (2) Determination of design concept so as to best satisfy such quality targets as and when developed.

##### Step 2.

Preparation of "Quality Table (1)", by which the co-relation between each item of quality assurance and each element of design criteria is evaluated.

##### Step 3.

- (1) Preparation of "Table of Technology Required", which lists all elements of proven technology and data necessary for achieving quality targets and whether they are available within the company's in-house resources or not, is carefully checked.

- (2) Undertaking of "Failure Mode and Effect Analysis (FMEA)", by which all foreseeable causes of failure which may affect the required function of the subject of construction are evaluated.
- (3) Combining the results of above (1) and (2), it is then determined whether or not further R-and-D and/or field test must be conducted by the Company's Research Center and/or his Construction Technology Dept.

Step 4.

If the execution of R-and-D and/or field tests, is required then methods and techniques of the scientific QC, are fully utilized such as:

- regression analysis
- analysis of variance
- design of experiment
- etc.

Step 5.

- (1) Feeding back results of Step 4. to "Quality Table (1)".
- (2) Determination of every basic element of design criteria.
- (3) Execution of design, including structural and electro-mechanical design, and preparation of all technical documents including specifications, drawings and others.

Step 6.

- (1) Preparation of "Quality Table (2)" by the Company's construction organization, in which are specifically described such matters as:
  - at which stage of construction process,
  - what points of quality must be checked,
  - in reference to what standards,
  - by what ways and means,
  - under whose responsibility,
  - how records must be kept,
  - what remedial action must be taken, should it become necessary, and under whose responsibility
- (2) Preparation of "QC Process Chart" by the Site Organization basing on "Quality Table (2)".
- (3) Execution of construction in strict accordance with "QC Process Chart".



### 3.2 Example: Development of Large-sized PC Cryogenic Tank

As a result of the rapid increase of LPG and LNG importation after the 1974 oil crisis, there emerged a need for safe and economical storage of LPG and LNG at cryogenic condition. In line with such trend, above mentioned contractor undertook the planning, designing and construction of a large-sized PC cryogenic tank. How the above-stated steps of QA activities were applied in this case will be presented using slides or OHP at the Tokyo Symposium.

#### 4. FUTURE ISSUES

The foregoing characteristics of QA activities are a result of accumulation of many years' activities in manufacturing companies. The writer believes that

even in the construction industry, methods that take the industry's distinctive characteristics into account should be studied and developed in order to establish QA activities that are both systematic and scientific.

- a. Establishment of a method of evaluating the quality of public works and buildings, such as evaluation by users.  
(The term "quality" includes quality of work, costs, delivery dates, and safety)
- b. Allocation of roles and responsibilities related to quality assurance, such as among client, engineer, and contractor.
- c. Penetrating understanding and consideration of human aspects, such as study of human error.