RESEARCH IN ESTABLISHMENT OF QUALITY CONTROL AND RISK MANAGEMENT SYSTEMS

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ABSTRACT: If all data, records, checklists and photographs accumulated during quality checks and labor safety inspections at construction sites are not systematically arranged, stored and tracked. The status of improvements is not confirmed and tracked in a timely manner, not only will engineering quality and construction safety be influenced but work load at construction sites will increase. In view of the above scenario, development of a quality control (QC) and risk management system is a matter of priority.

The quality control and risk management system we developed focuses on streamlining time and human resources at construction sites to reduce costs, and improve the quality of construction and health and safety practices. In a plan-do-check-action (PDCA) cycle, the system passed efficiently the two procedures, check, and action, to improve the implementation capability in construction sites and competitiveness in the market.

***Keywords**: Quality Inspection, Quality Control (QC), Risk Management, Risk Control*

1. INTRODUCTION

The system utilized computer to conduct quality control and risk management of construction for a construction site office. The system included actual construction site status, inspection records, tracking of improvement measures, control measures in construction progress and disposal of obstacles. The related QC reports were presented according to the Seven QC tools. We established a database for each, including construction plans, QC organization, quality plans, checklists for materials and construction, and self-inspection checklists of health and safety. We processed the control of nonconforming items, corrective and precautionary measures, control of construction progress, and the performance status of work catch-up plans. Depending on different requirements of different construction projects of different scale, we could implement the QC system and perform tracking of risk management, control of construction duration and major incidents, removal of construction obstacles, and confirmation on the adequacy of strategies. According to risk management procedures, we implemented hazard identification, risk assessment, and risk control.

2.RESEARCH PURPOSES

The purpose of this system is to assist construction companies to develop a standardized quality control and risk management system.

- To assist engineers in fully understanding the main points of quality inspection in each

construction phase, and reduce construction quality defects.

- To allow inspectors to fully comprehend the defects found in quality inspection and track the improvements schedule.
- To comprehend abnormalities through statistical analysis and produce warning signals.
- To conduct hazard identification, risk assessment, and risk control according to the risk management procedures.

3. INSPECTION TASKS

(1)Inspection frequency:

Regular inspection, random inspection, statutory inspection, and node inspection

A. Regular inspection:

a. Designated inspection:

Before the end of each month, staff on the quality committee plan for the sites they will inspect the next month, and conduct inspection according to the arranged schedule.

b. Quarterly inspection:

Every three months, full-time staff and quality committee members must inspect all the sites at least once, as well as conduct a review of defects and a quarterly assessment. In the process of quarterly inspection, after inspectors from the quality committee have filled in the engineering quality inspection form according to the actual conditions found at the site, the form must be signed by the head of the engineering office. This form is then used as a basis for quarterly inspection assessment.

B. Random inspection:

a. Random inspection:

Employees from the quality committee irregularly and randomly inspection various engineering processes at different locations.

b. Randomly drawn inspection:

Once every three months, in the directors' meeting, the chairman or vice-chairman of the quality committee makes labels listing the existing construction projects of every department and randomly draws one label from the jar. The randomly drawn construction site is then inspected. Apart from construction site inspection, this inspection also includes inspection of quality control documentation, and inspection of internal operations such as the management information system.

C. Statutory inspection:

When legal procedures require the presence of technicians or engineers for various engineering operations, company engineers or technicians conduct statutory inspection according to the needs of each engineering project.

D. Node inspection:

a. Arrange the work items and proposed date of the node inspection prior to the start of each engineering project, according to the characteristics of each project and the internal control progress chart, and provide the quality committee with this information along with the internal control progress chart.

b. Following the commencement of construction, fill in the "Application Form for Segmented Engineering Inspection", according to the actual progression of construction.

(2) Construction site inspection:

1.Inspect each measurement of the structures, the precision of construction, and the details of construction quality.

2.Inspection of material quality; must include sampling and inspection of specific materials when necessary.

3.Inspect occupational safety factors and environmental protection measures of the construction site.

(3) Inspection of quality control documentation:

Engineering office:

Construction log, various quality control self-inspection checklists, record of material inspection (testing) or review, measures for control/correction/prevention of substandard products.

Quality control engineers:

Records of review of construction plan and quality control plan, records of quality inspection of engineering processes and defect tracking, records of material quality testing

Written inspection:

Check whether the information in various construction site reports was filled in on time and is comprehensive in content.

(4) Seven main techniques of quality control (QC)

The seven main conventional tools or methods for QC include the following: Pareto Chart, Cause and Effect Diagram (Fishbone Diagram), Histogram, Control Chart, scatter diagram, inspection table (also known as inspection table) and the stratification method. In the control chart developed by this system, statistical methods are used to calculate the center value and control limit. Abnormal variation and normal variation are differentiated on this basis.

4. SOFTWARE

- 1. Software Development Tools: Delphi
- 2. Database: MS SQL Server
- 3. Output reports: MS Excel

5.SYSTEM STRUCTURE

This system consists of the following seven modules; the relationships among the modules are shown in the following figure.

1. Basic engineering information module

2. Quality control module

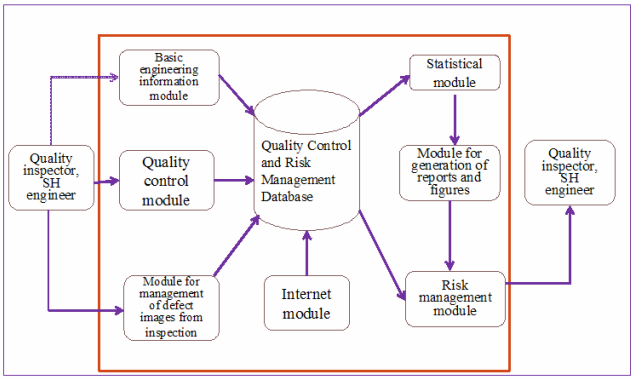
3. Module for management of defect images from inspection

4. Statistical module

5. Module for generation of reports and figures

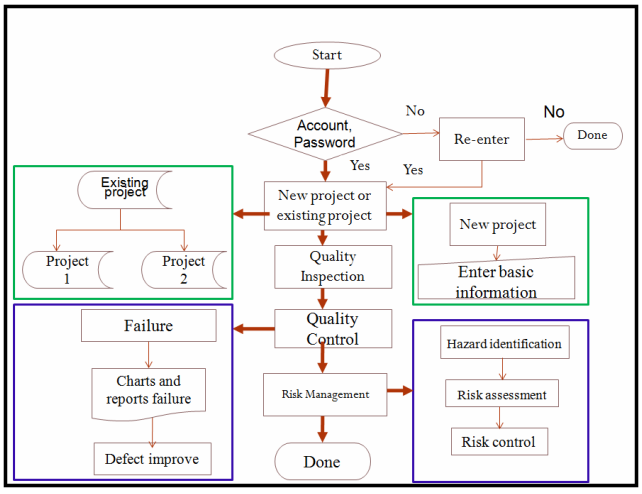
6. Internet module

7. Risk management module



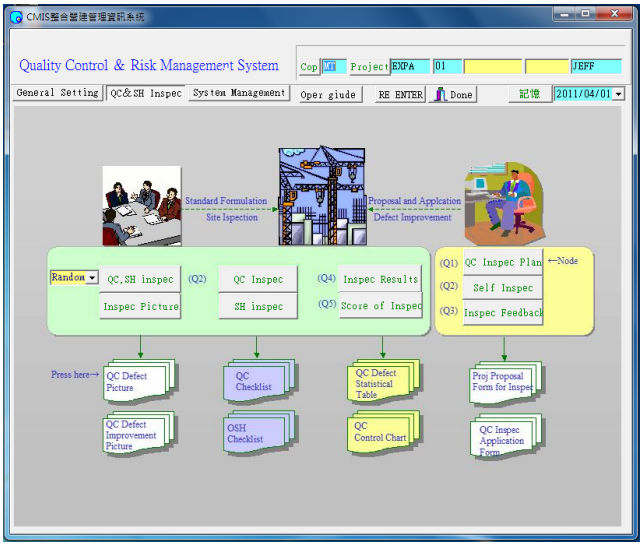
6.SYSTEM FLOW

Upon entering the system, first “enter account number and password”, enter the “general settings” interface, and enter basic information on the engineering or construction project. After entering the “quality inspection” system, calculate quality statistics according to the “seven main techniques of quality control (QC)”. Enter the “occupational safety and health inspection” system and execute “risk management”, including hazard identification, risk assessment, and risk control. System procedures are shown in the following figure.



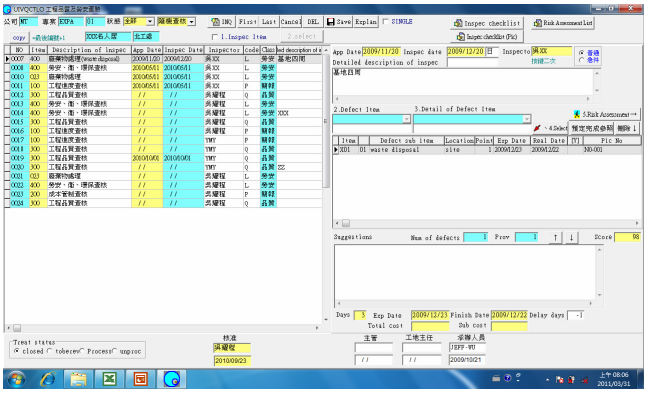
7.EXPLANATION OF MAIN OPERATION SCREEN OF SYSTEM

7.1. Click [QC&SH Inspection] to enter the main operations page



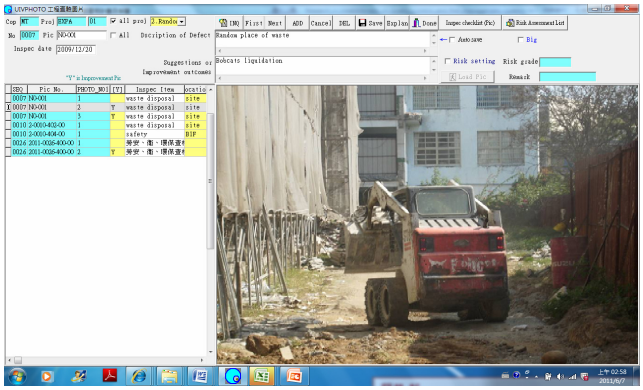
7.2. Plan and application form for segmented node inspection

Each construction site submits an inspection plan and application form according to the node inspection system. After the inspection, the construction staff has a clear understanding of defects that require improvement.



7.3. Engineering inspection tasks

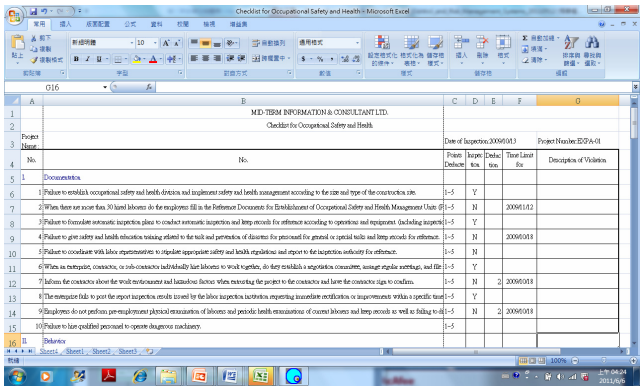
The quality inspection committee has full control of various inspection applications and can access defect images and manage engineering photographs.



7.4. Regular quality inspection and rating: Enter and mark inspection results

- Statistical table of quality inspection effectiveness: Track post-inspection improvements; conditions of improvement are divided into “case closed” and “to be reviewed”. To be reviewed cases are continually tracked.

7.5. Occupational Safety and Health Checklist: Enter the results of the Occupational safety and health inspection to facilitate continued tracking.



7.6. Hazard table

Occupational safety and health staff use the sub-items of the Occupational Safety and Health Checklist to identify hazards to occupational health and safety, and implement risk assessment and risk control.

Hazard identification can be assessed from the angles of probability (P) of occurrence and severity (S). The score

of the danger level is used to establish risk rating. The risk rating is then used to determine whether control measures should be implemented.

7.6.1 Probability analysis

Occupational safety and health staff should carefully review all information on hazards and determine the probability of hazardous events according to their optimum professional judgement. Occupational safety and health administrators should use the table below to determine the probability rating range for the occurrence of hazardous events, and enter these ratings into the hazard records.

	Category	Description	Frequency
5	Very Frequent	Likely to occur on a few occasions per month	>10/year
4	Probable	Likely to occur on a few occasions per year	≧1/year-≦10/year
3	Unlikely	Likely to occur once per 10 years	≧0.1/year-<1/year
2	Very Unlikely	Likely to occur less than once per 10 years	≧0.01/year-<0.1/year
1	Improbable	Likely to occur less than once per 100 years	<0.01/year

7.6.2 Severity analysis<0}

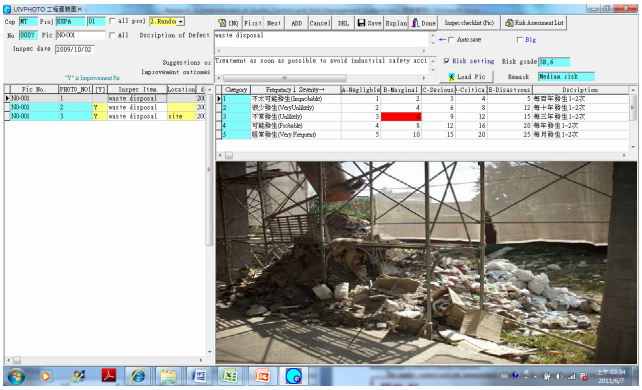
Occupational safety and health staff should carefully review all information on hazards and determine the severity of the occurrence of hazardous events according to their optimum professional judgement. Occupational safety and health administrators should use the table below to determine the severity rating range for the occurrence of hazardous events, and enter these ratings into the hazard records.

	Category	Fatalities	Major Injury	Minor Injury	Psychological Effects
5	Disastrous	≧5	>50	>500	Reputation of company seriously jeopardized
4	Critical	≧1	Several (5-50)	Multiple (51-500)	Incident causing lasting trauma for those involved
3	Serious	—	Few(<5)	Several (5-50)	Incident creating a significant short term impact on those involved
2	Marginal	—	—	Few(<5)	Incident causing distress or concern to group
1	Negligible	—	—	—	Incident causing distress or concern to individual

7.6.3 Risk assessment

Refer to the risk rating table below to assess the risk rating of hazardous events according to the results of probability analysis and severity analysis.

Category	1 › A Negligible	2 › B Marginal	3 › C Serious	4 › D Critical	5 › E Disastrous
1 Improbable	1	2	3	4	5
2 Very Unlikely	2	4	6	8	10
3 Unlikely	3	6	9	12	15
4 Probable	4	8	12	16	20
5 Very Frequent	5	10	15	20	25



7.6.4. Risk rating/risk category table

The results of risk rating are divided into three categories:

1. Unacceptable risk: Risk must be reduced
2. Medium risk: Risk must be reduced
3. Acceptable risk: Risk in this category generally does not require reduction

Risk Class	Represented meaning	Description
15~25	Unacceptable Risk	risk must be reduced
5~12	Medium Risk	risk must be reduced
1~4	Acceptable Risk	Risk in this category generally does not require reduction

7.6.5. Formulate Risk Control Measures (RCMs)

1.Following risk assessment, with regard to unacceptable risks and moderate risks, occupational health and safety administrators should formulate control measures for reduction of these risks.

2.Fill in the “control measures” (proposal and recommendations for improvement) field:

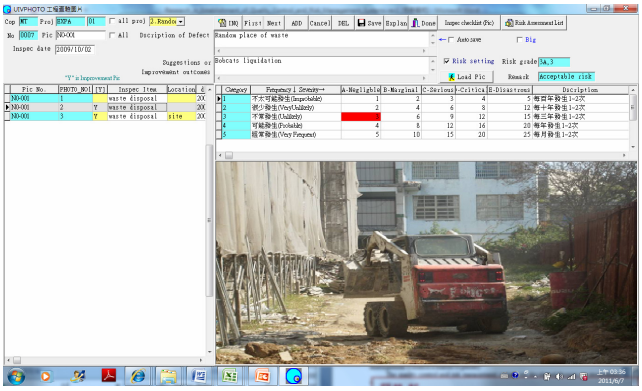
Occupational safety and health administrators should

enter the RCMs formulated into the “control measures” field of the hazards record.

7.6.6. Residual risk assessment

Implementation of RCMs should reduce the probability (P) of the occurrence of hazardous events and/or the severity (S) of repercussions. After implementing RCMs, occupational health and safety administrators should enter the probability (P) and severity (S) ratings of the hazards into the corresponding fields (P and S) in the “residual risk” section of hazard records.

The goal of implementing RCMs is to reduce the risk rating of hazards to “acceptable risk”. Occupational safety and health administrators should examine the rating of residual risks and distinguish those residual risks that are still rated as unacceptable risks or moderate risks. Necessary RCMs must then be re-formulated to reduce the rating of these risks to acceptable risk.



8.CONCLUSION

The system effectively and systematically arranged, stored, and tracked all of the data and records accumulated during quality checks over time, and timely confirmed improvements, promoted construction quality and decreased risks at construction sites, which we believe is a useful contribution to overall safety.

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