

AUTOMATIC MANAGEMENT OF THE WIDENING PROJECT OF THE CHUNGSHAN FREEWAY

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Abstract : Besides introducing every kind of implementation of quality control institution leading to automatic management implemented by this Bureau in recent years, the management system also leads in the widening project of the Chungshan (NH1) Freeway executed by stages. By the performance of the standard and systematic quality management institution, we can keep with the society movement and attain the purpose of labor simplification of the government.

Keywords : quality control ; standardization ; systematization ; three grades quality control ; three steps and four grades quality control

1. Introduction

It is 20 years since the whole length of the Chungshan Freeway (NH1) was opened to the public. The NH1 is the most important transportation line from north to south because it provides a fast, comfortable service. The northern section of the freeway has been saturated since 1987. According to the estimation, the NH1 shared 63% of the North-South traffic volume in the west part of Taiwan and it is congested in rush hours in urban area. The annual traffic volume has been increased from 93 million vehicles in 1980 to 313 million vehicles in 1983, and it was 434 million vehicles in 1999 (table 1).

In order to resolve the increasing traffic congestion, the widening project of the NH1 is one of the essential implementation under the condition of densely populated and limited land coped with rapid growth of the domestic economy. Besides the duration, environmental protection and technology aspects of the construction, the widening project of the NH1 which daily traffic volume exceeds 1.13 million vehicles and has a total length of 373.2 KM must overcome every kind of problem produced by traffic controls for street and highway construction, length and narrow of construction operation aspect and cross or parallel pipes of oil and gas and telecommunication. Therefore, automatic management shows its importance.

2. The quality institution of this bureau and ISO9001

2-1 *A quality control of three grades*

This quality control system originated in

the establishment of the Northern Taiwan Second Freeway engineering Office which was for constructing the NH3 (Second Freeway). This quality control system examined the quality institution which was executed in the construction of the NH1 and it was executed in the widening project of Shijr-Wugu section. The system divided into quality assurance and quality control. The quality assurance was composed of investigation and examination. The quality assurance operation would run smoothly by the procedure of investigation and examination. The quality control was composed of construction examination and material test. The contractor executed the process quality control. (fig1)

2.2 *A quality control of three steps and four grades*

This system coordinates every kind of measures taken by the Executive Yuan Committee to improve the quality of our public construction. It checks the existing quality guaranty institution of this bureau and has made an experiment since the middle of 1994. 「The quality Management Institution of the Public Construction」 has been revised and promulgated formally since July 1996. It changes little in the structure and execution of the original quality assurance system, just adds an examination operation for the project more than fixed funds. The process of this

system practices by classifying three steps and four grades of the directors, executors, supervisors and constructors (Fig 2). In addition to stipulating in explicit terms of the institution, responsibility, procedure, examination timing, target, pattern and principle. It also has awards and penalty for the result of the examination.

2—3 *Lead in ISO 9001*

The construction companies were splendid in the era of Ten Major projects. Most of the companies transformed the direction of business or went bankrupt because the projects ceased. When the six-year-construction began, the construction companies recovered again. Most of the companies opened business or changed hurriedly because of the hot property, but they neglected the establishment of quality control institution and professional technicality. All of the public construction projects are supervised and controlled by the interior technical consultant companies and most construction companies accept thoroughly, so the construction companies improve little in quality control institution and professional technicality. In order to improve the quality of the interior construction and the concept of the quality control, the Executive Yuan promulgated the 『Quality Control Institution of Public Construction』 on Oct 7th, 1993, and took the evaluation and guidance of the quality of public construction positively.

In order to make the quality control measurements carried out, this bureau chose the Widening Construction Office from one of the subordinate offices to try out the ISO 9001 international quality management and assurance institution. By the standardization, institutionalization and efficiency of doing business of the owner, we let the constructors cooperate positively in the project and establish the characteristics of quality control. Therefore we can carry out the quality control of the constructor in the project, and reach to the purpose of simplifying the manpower of the government.

The Widening Construction Office led in ISO 9001 on the basis of original quality institution of the normal operation, in accordance with normal standardization, construction technical standardization, standard operation procedure. Laws and regulations promulgated by the government. Therefore, The Widening Construction Office finished the draft of every kind of training and documents and tried it on Apr 8th, 1997 in the structure of twenty basic requirements of ISO 9001 quality system. The office was accepted and evaluated well on June 26th and 27th, and it made a precedent that the government construction office was approved by ISO 9001 national quality management and assurance institution on July 8th. It

has practiced well on the systematization of interior operation, and established a good foundation of construction automation of the widening construction office. The practical advantage was that it made the widening project of Shijr-Wugu section delayed much finished at the end of Oct. 1997, by using the management methods thoroughly and ISO 9001 institution without losing the quality of the project. The project above was completed ahead of schedule one month. The Yangmei-Hsinchu widening project also got the honor of Golden Road Prize by the Ministry of Transportation and Communications. The Yuanlin-Kaohsiung widening project also operates in accordance of the concept, so as to supply a project of good quality for the people. We can see the operation system in fig 3.

3 • **The Widening Project of NH1 and Construction Management Implementation**

3.1 *The widening Project of NH1*

The traffic capacity of the NH1 is saturated with rapid growth of the domestic economy and development of the villages and towns along the freeway line. The traffic congestion of the freeway is serious in urban area. In order to resolve the increasing traffic congestion, this bureau put several management implementation into practice in the aspect of transportation, toll and service area. We also made a planned self-criticism of the congestion and dangerous freeway line. Therefore, this bureau made the widening project step by step on the plane section or viaduct. (table 2) The basic principles of widening follows :

- In the principle of not adding land as far as possible, The freeway was widened outside in the legal scope and was put R.C. barriers on the shoulder.
- The width of a lane was reduced from 3.75M to 3.65M ; the interior shoulder and the exterior shoulder keep 1M and 3 M.
- The median strip without enough land was replaced R.C. barriers ; otherwise, the freeway kept the same median strip.
- Depending on the estimate highest flood level, the widening project evaluated the net height of free flood level of all bridges and local drainage works.
- The widening project of the freeway was carried out depending on the local transportation and future development.
- The widening project examined the horizontal and vertical section of the freeway where caused accidents easily, and it improved the field of vision and local environment facilities together.
- The construction style and relative responses affected the ordinary transportation little.

3-2 *The Construction Management Implementation*

In order to strengthen the construction accomplishment of the widening project and put quality management into practice, the Widening Construction Office coordinated every kind of operation. The supervision was executed by combining the elementary construction office and the professional consultant company. The quality control of material was executed by combining material test office and the professional consultant company. The structure of all the organization was planned depending on the target ; by the way, it made every kind of management implementation the executed principles.

- The correction of the standard and relative rules
We corrected the rules according to collecting the difficult and countermeasure of the important construction projects in Taiwan, for example, the government purchase law, the price index, adjustment law, the labor safety and health law, the quality control institution of public construction, the evaluation rules of contractor qualification.
- The operation standardization
By eliminating the man-made factors, it established the standard operation procedure structured by ISO 9001 quality assurance institution.
- Establish the examine institution of the contractors qualification
The main examine items included outstanding achievement, capital in debt, machine instrument and employee qualification. Finally, it adds some examine items including the quality and the executive ability of the contract projects.
- The project documents
The contractor must write the construction basic plan drawings, quality control plan and material test plan according to the contract. The contractor must make some checkpoints, check lists and management of document records and establish a quality control organization. By the way, the charger of the quality control organization is equal to the charger of the construction site.
- The examination of the quality control employee
Besides matching the relative rules of this bureau, the employee of the quality control must match the rules of the quality control institution of public construction. They can work after finishing the examination.
- The execution of the sign in of the professional technician
Every kind of drawings and plans must be signed in by the professional technician in the construction process. The technician must explain or attend an examine meeting if necessary.
- Establish the environment survey and protection system in the construction process.
- Strengthen the safety and health operation and examination of the construction site.
- All construction material must be examined first

by the national laboratory which is identified.

- Professional training.
This bureau invited some professional technicians, scholars and pavement professors in America to make some instructions of land, concrete, soft and rigid pavement , prestressed force structure.
- The quality self-control of the contractor
The contractor must execute the project according to the examined plan and make self-test operation.
- Practice the quality institution (fig 3).

4.The application of construction automation

The widening project of the NH1 which was more than 370 KM in length was more difficult than any other newly-construction freeway. The number of the organization of the widening Construction Office (including administration employee) is less than 100 persons. In order to make the widening project finished publicly on time, every kind of construction management implementation played an important role in the process of the project.

4-1 The application of construction management system P3

In order to make the project executed smoothly and grasp the rate of the progress correctly, P3 was a special management tool operated in the basic plan of the construction plan. In the grasp of schedule, They understood the difference of the realistic and predetermined project schedule by comparing the realistic and target project. They made a self-criticism and looked for a solution when the rate of progress fell behind.

The widening Construction office also used the predetermined schedule to be the foundation of the construction evaluation ; by the way, if the project had obstacles, they used the construction critical plan to be the proof of the postpone of project schedule.

4-2. The Application of AutoCad

The amount of the widening project of the NH1 was between hundreds of millions to billions. All the drawings of stake place, cadastral map, structure and standard map were over hundreds.

The contractor must make construction drawings according to the documents above, and executed the project after all the drawings examined. Finally, the contractor must make the completed maps of the project. The amount of all the drawings was too much for the few operators to be competent. Therefore, in order to reduce the waste of large manpower and resource, every project made all the documents above by AutoCAD to improve the quality of the operation.

4-3. The application of office software

Most of the administration, quality control and

presentation documents were finished by the WORD, ACCESS, Excel and Powerpoint software. The widening construction office has finished all the documents computerized since the end of 1998.

4-4. The application of Internet

In order to avoid the waste of large resource because of repeated works, the widening Construction office also established the internet equipment thoroughly at the same time of completing all the documents computerized in 1998.

Besides the sharing of resource, it was used to be the transmission between the local offices and chief office.

5. Conclusion

The widening project of the over saturated NH1 could not be executed well by traditional management style. The management style of V.

7. Appendix

construction automation is a good tool for the widening construction office to finish the widening project. It is also a good tool for all the service and management operation of this bureau.

6. Reference

- I. Ho Nuan-Hsuan, 「The widening project of the NH1 and transportation management」, Taiwan Area National Freeway Bureau, 1998.
- II. Taiwan Area National Freeway Bureau, 「Construction Standard Operation Procedure」, 1991.
- III. Taiwan Area National Freeway Bureau, 「Construction Quality Management Institution」, 1996.
- IV. The widening Construction Office of Taiwan Area National Freeway Bureau, 「Construction Standard Operation Procedure」, 1999.

Table 1 The growth rate of the NH1 between 1991 and 1999

Year	A. Traffic volume/day (10000 vehicles)	B. Designed volume / day (10000 vehicles)	A / B %
1991	81	66	123%
1992	83	66	128%
1993	88	66	133%
1994	94	87	109%
1995	101	87	116%
1996	104	87	120%
1997	108	87	124%
1998	113	87	130%
1999	119	87	137%

*The Hsinchu-Chungho section of the Northern Taiwan Second Freeway (NH3) has been opening since Aug 1993, and the Hsichih-Hsinchu section has been opening since Aug 1997.

Table 2 The widening projects of the NH1

Section	Opening time	Items	P/E
			Benefit
Linkou to Yangmei (26KM)	Jun,1986	<ul style="list-style-type: none"> ◇ 8 lanes on both sides ◇ Improvement of interchanges and service areas 	-----
Shijr to Wugu (21KM)	Oct,1997	<ul style="list-style-type: none"> ◇ Viaduct structure along both sides ◇ Two lanes added in each direction,and three lanes between Huanho North Road and Wugu interchange 	2.36
			14.0%
Hsinchu to Yuanlin (112KM)	Dec,2002	<ul style="list-style-type: none"> ◇ One lane to be added to both sides. ◇ Construction of newly interchanges 	4.5
			24.86%
Yangmei to Hsinchu (28KM)	Dec,2003	<ul style="list-style-type: none"> ◇ One lane to be added to both sides. ◇ Improvement of interchanges and service areas 	4.7
			41.72%
Yuanlin to Kaoshiung (158KM)	Dec,2007	<ul style="list-style-type: none"> ◇ One lane to be added to both sides. ◇ Viaduct and parallel frontage road in Tainan area ◇ Improvement of interchanges and service areas 	2.38
			22.3%

Fig 1 Three steps management institution of construction quality

		Freeway Bureau
Quality Assurance	Quality Examination	Construction Office
	Quality Identification	Elementary Construction Office
	Quality Control	
	<ul style="list-style-type: none"> ➤ Construction Examination ➤ Material Test 	Supervision Consultant Company

Quality Control		
	Quality Control in the process	Contractor

Fig 2 Three steps and four grades management institution of construction quality

Third Step	Quality Management	Quality Examination	Freeway Bureau	Fourth Grade
Second Step	Quality Assurance	Quality Examination	Construction Office	Third Grade
		Quality Identification	Elementary Construction Office	
		Quality Control	Supervision Consultant Company	
First Steps		<ul style="list-style-type: none"> ➤ Construction Examination ➤ Material Test 		Second Grade
	Quality Control			
		Quality Control in the process	Contractor	First Grade

Fig 3 A Correction of three steps and four grades management institution of construction quality

Third Step	Quality Management	Quality Examination	Freeway Bureau	Fourth Grade
Second Step	Quality Assurance	Quality Examination	Construction Office	Third Grade
		Quality Identification	Elementary Construction Office (Supervision)	Second Grade
		<ul style="list-style-type: none"> ➤ Construction Check ➤ Material Test 		

First Steps	Quality Control	Quality Control in the process		
		<ul style="list-style-type: none"> ➤ Construction Examination ➤ Material Test 	Contractor	First Grade