

THE STATUS-QUO AND CHARACTERISTICS OF CHINESE ENTERPRISES MAINTENANCE AUDIT ASSESSMENT

Baogiang Xu*

Industrial & Plant Engineering Institute of Guangzhou University, Guangzhou, China

Baowen Li

Industrial & Plant Engineering Institute of Guangzhou University, Guangzhou, China

Other than selecting maintenance performance index and certain benchmark to lead enterprises making progress in Europe, Maintenance management level of equipment in China is assessed by the audit system establishing. The first edition of Total Normalized Productive Maintenance Management Systems-Requirements was released in 2005, named TnPM Five-Rank & Six-Dimension Audit System. The equipment management and maintenance level of Chinese enterprises were audited systematically from that time on.

The Audit System divides the equipment management and maintenance level into 6 dimensions, which include about 100 items. There are more than 800 auditing points and the total score are 1000-points as well. Five ranks differ maintenance level of enterprises from confusion to excellence. The final score will present the level of the enterprise in equipment maintenance management.

From 2006 to 2011, enterprises from different industries like oil and chemical, chemical fertilizer, manufacture, subway, tobacco, power plant and mine apply for TnPM maintenance Audit actively. Some of the headquarters would like to know the equipment maintenance management condition of their branches through this audit system. The assessment of the equipment maintenance management condition as well as the management problems identifying has been done through the problems distinguishing and checking. The suggestions which are proposed after the audit assessment will help enterprises to be world-class-manufacture.

Keywords: Audit, TnPM, five-rank six-dimension, enterprises, maintenance management, status quo

INTRODUCTION

Audition could guide industry to reach a consensus in enterprises' maintenance management level. However, different countries and Organizations have different implementation road-map during specific practicing. Under the guidance of EFNMS, the Standard of PrEN15941 was released and typical KPIs as well as its' Bench Marks were established. So enterprises can improve themselves according to these indicators and benchmarks.

As a Chinese researching and consulting organization, the team of Total Productive Maintenance Committee, CAPE, which focuses on maintenance management, has also concerned about this topic: How to judge the level of Chinese industry on plant maintenance? It is difficult for China to build some general indicators to audit all the enterprises like in Europe because there

are too many various types of industrial enterprises and every enterprise has their own unique condition and different development stages. We take a systematic and comprehensive evaluation method.

We will introduce the auditing measures for Chinese enterprises' plant maintenance management level specifically.

THE DEVELOPING PROCESS AND STRUCTURE OF CHINESE AUDITING SYSTEM

Developing Process

Since 2004, researching team of Total Productive Maintenance Committee, CAPE started to compile the plant maintenance management standards after detailed survey among typical industries in China. First version of Total Normalized Productive Maintenance (TnPM) Manage-

ment Systems-Requirements, which released in 2005, pushes maintenance management to gain great progresses. This Requirements was used to guide the promotion of enterprise equipment

maintenance and overhaul management level. The Requirements was revised several times in the following years. The main events about the Requirements are as following in Table 2.

Table 1: The comparison of two audits

	EFNMS	In China
Evaluation process	Led by Organization-Choosing KPIs Working out Bench Marks-Finding out weak point and improve it. Choose the KPIs and then set-up the Bench Mark	Focus on the process and the results. The audition is result-orientation and different levels indicate the present level and improving direction
Criteria or Tools	Balanced Score card (BSC)	Total Normalized Productive Maintenance(TnPM) Management Systems-Requirements
Features	<ul style="list-style-type: none"> • KPIs cover many aspects like finance, procedure, customer satisfaction and Innovation; • KPIs are selected from excellent enterprises; • Indicators are easy to understand. Audition and its' use are very convenient. • Focus on the result. However, it sometimes cannot reflect the Actual situation 	<ul style="list-style-type: none"> • Auditing from six aspects and the results as well as the procedures are also important. • The period of the audition is long.

Table 2: The main events about TnPM Requirements

Year	Event
2004	Starting to form the Draft of requirements
2005	Publishing trial version of the Requirements and 5-Rank's Assessment of TnPM Manual
2006	Compiling Grade in 5-Rank's Assessment of TnPM
2008	2008 Version Issued. Criteria of Ranks division are revised.
2010	2010 Version Issued

Structure of the Requirements

We name this requirements as TnPM Five-Rank Six-Dimension Audit Standard. There are three files.

- Total Normalized Productive Maintenance(TnPM) Management Systems -Requirements (2010 Version)
- 5-Rank's Assessment of TnPM Manual
- Grade in 5-Rank's Assessment of TnP

Terms Explanation:

- TnPM: TnPM stands for Total Normalized Productive Maintenance. It is the general name of elaborate man-machine management system which emphasizes total participation and step by step implementation. It

is a maintenance management system that improves OEE through norms formulating, acting standardizing, effects auditing and sustainable improving.

- Five Rank: Five-Rank Six-Dimension Audit System is based on six valued logic system. The five ranks lead enterprises progress step by step. First Rank means the normal level and Five Rank indicates the excellent level. The auditing team will grade the enterprise according to the audition rules. There are total 1000 scores and different scores represent different ranks. The division of the scores is shown in Table 3.

Table 3: Division of the scores in Five-Rank Six-Dimension Audit System

Rank	Scores	Remarks
Rank 1	500 - 670	500+About 500*(5/15)
Rank 2	671 - 800	Upper level + About 500*(4/15)
Rank 3	801 - 900	Upper level + About 500*(3/15)
Rank 4	901 - 970	Upper level + About 500*(2/15)
Rank 5	971 - 1000	Upper level + About 500*(1/15)

Table 4: Structure of Five-Rank Six-Dimension Audit System in 2010 Version

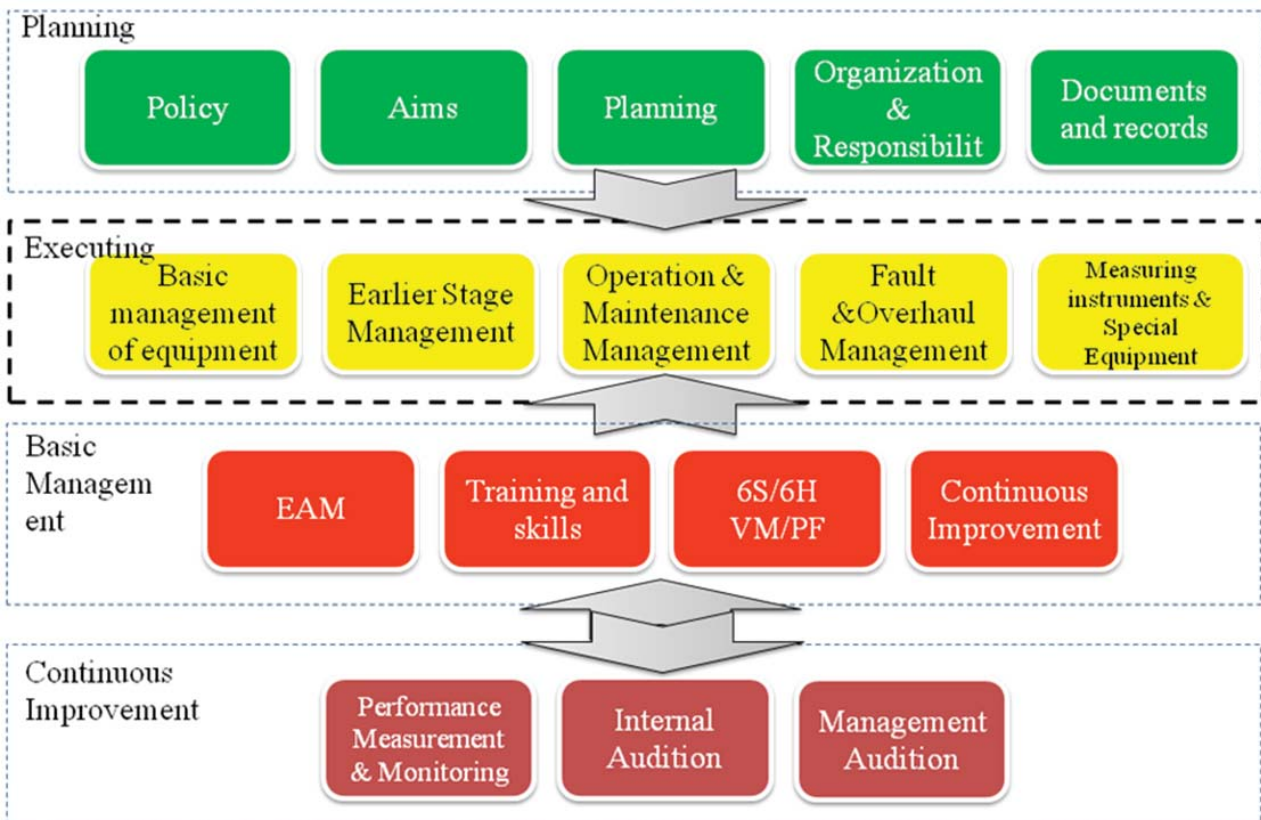
First-Stage, 6 Points	Second-Stage, 15 Points	Third-Stage, 13 Points
4.1 General Requirements		
4.2 Policy		
4.3 Planning	4.3.1 Aims	
	4.3.2 TnPM Maintenance Management System Planning	
4.4 Implementation & Function	4.4.1 Organization & Responsibility	
	4.4.2 Training	4.4.2.1 Training
		4.4.2.2 One Point Lesson (OPL)
	4.4.3 Requirements of Files & Records	
	4.4.4 Four Elements of Shop Floor	
	4.4.5 Maintenance Management Planning	
	4.4.6 Basic management of equipment	4.4.6.1 Basic Information of Equipment
		4.4.6.2 Technical Criterion
		4.4.6.3 Equipment Assets Management
	4.4.7 Earlier Stage Management	
	4.4.8 Operation & Maintenance Management	4.4.8.1Autonomous Maintenance (AM)
		4.4.8.2 Inspection & Condition Monitoring
		4.4.8.3 Lubricating Management
		4.4.8.4 Measuring instruments & Special Equipment Management
	4.4.9 Fault & Overhaul Management	4.4.9.1 Fault Management
		4.4.9.2 Overhaul & Repair Management
		4.4.9.3 Equipment scrapping & Replacing Management
		4.4.9.4 Spare Parts Management
	4.4.10 Knowledge Management & EAM	
	4.4.11 Continuous Improvement (CI)	
4.5 Checking & Correcting Measures	4.5.1 Performance Measurement & Monitoring	
	4.5.2 Internal Audition	
4.6 Management Audition		

- Six Dimension: Dimension actually represents the audition areas. It includes the maintenance organization, normalization of management flow, conditions of shop floor and maintenance management execution, skills and morale of employees, computer application level of knowledge and maintenance management, indicators of maintenance management (efficiency cost, etc.)

Table 4 shows the structure of Five-Rank Six-Dimension Audit System in 2010 Version.

The Five-Rank Six-Dimension Audit System could improve the industry maintenance level of an enterprise through four aspects: planning, executing, basic management and Continuous Improvement, shown as Figure 1.

Figure 1: Audit System Guide Enterprise for Progress in Four Aspects



TNPM FIVE-RANK SIX-DIMENSION AUDIT IN CHINA

Chinese Enterprises have applied for audition spontaneously since 2006. There are total 38 enterprises which have got their certificates on auditing. (Figure 2 shows the numbers of applications every year.) The 38 enterprises cover Petrochemical industry, Chemical Fertilizer, Machining, Metro, Tobacco, Electric Power, Mines and so on. Sinopec Guangzhou, Nanjing Metro, China Tobacco Hunan Industrial Co., LTD. Chenzhou Factory, Mining companies of Ansteel Group now have their certificates of TnPM Five-Rank Six-Dimension Audit. (Figure 3 shows the industries distribution).

More and more enterprises realize the audition could help to find out their weakness and

improve effectively. Some Group would like to know the maintenance management conditions of the subsidiaries through Five-Rank Six-Dimension Audit.

FINDING OUT THE DISADVANTAGES FROM AUDITION RESULTS

Total flow of the Audition

A total audition flow is like the followings:

- Pre-audition Stage: Enterprises should apply for Audition in advance of more than half a year. After preliminary examination, the formal contract will be signed. An auditing team will be established and the checklist for audition will be released. Enterprises could prepare for audition accordingly.

The numbers of audit applications from 2006 to 2011

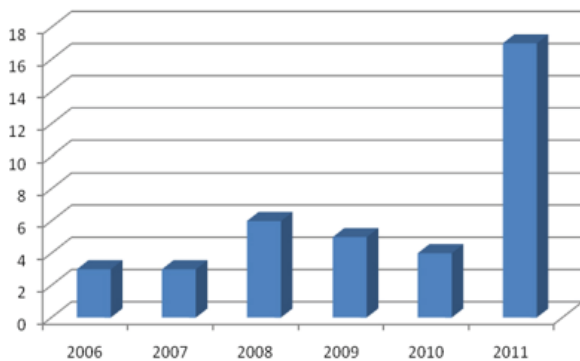


Figure 2: The numbers of audit applications from 2006 to 2011

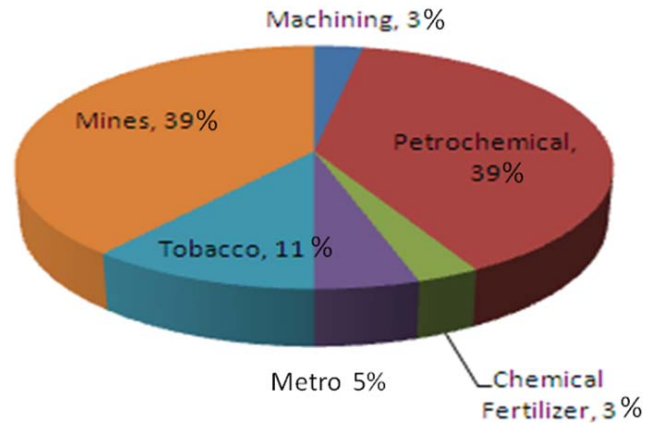


Figure 3: Industries distribution of audit application

- On-site Audition Stage: Generally speaking, the audition would last four days. The team will audit the enterprise according to Grade in 5-Rank's Assessment of TnPM. The audition contents include documents checking, interviewing, on-site checking, datas confirming and report listened. The informal suggestions and conclusion will be proposed at the end of the audition meeting immediately.
- Reporting Stage: The audit team will submit a

formal audition report and audition certificate in a month after the on-site audition. Specific scores in different fields, existed problems and improving proposals will be also in the audition report.

The Weaknesses of Chinese Maintenance Management Through The Audition

Table 5 shows on Main Items that the scoring percentage is under 70.

Table 5: Main Items that the scoring percentage is under 70

Auditing Items	Item Score	Average score	%
4.6 Management Audition	10.0	5.3	53.3%
4.4.11 Continuous Improvement (CI)	133.0	80.3	60.4%
4.3.2 TnPM Maintenance Management System Planning	18.0	11.0	61.1%
4.4.7 Earlier Stage Management	10.0	6.2	62.0%
4.2 Policy	8.0	5.0	62.5%
4.5.1 Performance Measurement & Monitoring	36.0	23.0	63.9%
4.4.4 Four Elements of Shop Floor	95.0	61.3	64.6%
4.3.1 Aims	36.0	23.5	65.3%
4.5.2 Internal Audition	18.0	11.8	65.7%
4.4.9.1 Fault Management	23.0	15.3	66.7%

For most Chinese enterprises, the weaknesses in plant maintenance management field are as follows:

- Lacking of general planning and policy on plant maintenance management, and as well as the periodic summary and improvement from the point of a system view.
- Plant Maintenance management and daily work which are under the guidance of maintenance management strategy, object man-

agement (OM) and KPIs should be strengthened.

- More attention should be paid on earlier stage management, especially LCP and LCC.
- On-site management, such as 6S, sources processing, VM, position fixation and so on should all be enhanced.
- The weaknesses also reflect on total participation and continuous improvement.

CONCLUSION

TnPM Five-Rank Six-Dimension Audit System could help Chinese enterprises to do self-diagnosis and systematic audition on plant maintenance management. The benefits of this audit to enterprises are:

- First is to expand the popularity and reputation for enterprises.
- Second is to improve plant maintenance management level through this audition. Because that the preparation process is just the process to implementing measures, and practicing lean management.

- Third is that the report of the audition will make enterprises know themselves thoroughly and to determine the developing direction in the future.

REFERENCES

- 1) Li Baowen, KPIs of Maintenance Management Level & Audition, Beijing, China Machine Press, 2007
- 2) Total Normalized Productive Maintenance (TnPM) Management Systems - Requirements (2010 Version)

Paper sent to revision: 28.05.2012.

Paper ready for publication: 25.06.2012.