ICAO

中国民用航空局
空中交通管理局
Air Traffic Management Bureau. CAAC

SMARTISED MAINTENANCE IN LARGE-SCALE AIR TRAFFIC MANAGEMENT AUTOMATION SYSTEM

Presented by China

CONTENTS

Growing Complexity in Maintenance

01

lin the background of continuously-growing air-traffic flow and the increasing system complexity, traditional maintenance is time and human-resource costing when dealing with large-scale Air Traffic Management Automation Systems,

Smartised maintenance can massively reduce human error by automated operation. And a management chain from warning, error-analysis, handling to review can be formed.

02

Traditional Maintenance versus Smartised Maintenance

	Traditional	Smartised	Improvement
System Inspection	Manual	Automated or Manual	7x24 Automated Inspection
Targeting Failure	Slow and Experience-driven	Precise and Data-driven	More Targeting
Data Backup	Manual	Automated	Automated Data Backup
Early Warning	No Early Warning	Early Warning Available	Data Driven Early Warning

CONTENTS

2.1 Fundmental Principle

01

Data Driven

Data within the system, hardware data, flight plan data, surveillance data, etc.

02

Key Shift

From Passive Failure-triggered to Proactive Prediction-triggered

2.2 Key Techniques

Indicator Prediction

Indicator Prediction and Dynamic Baseline Generation Method Based on Time Series Learning

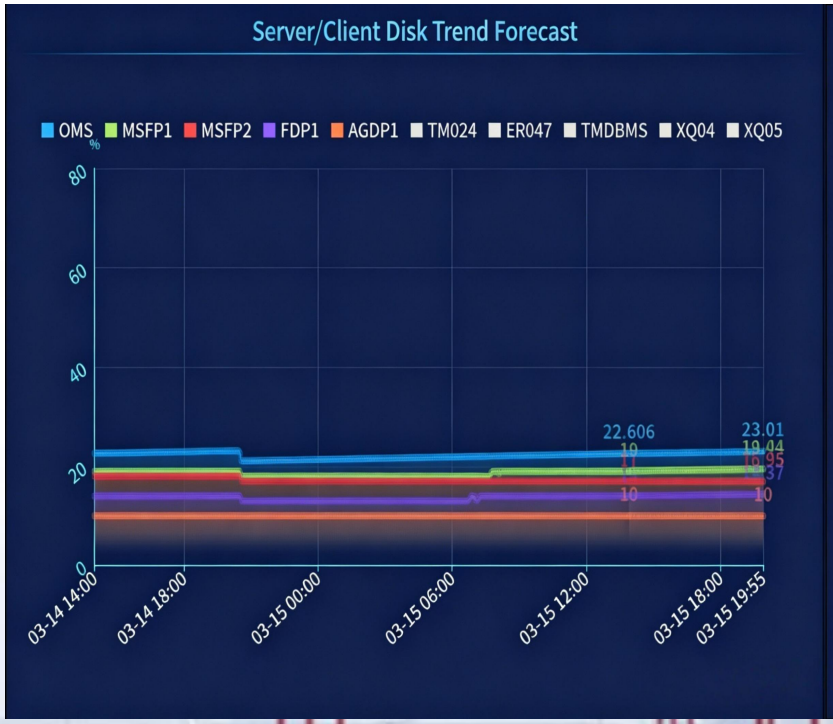
Automated Log Management

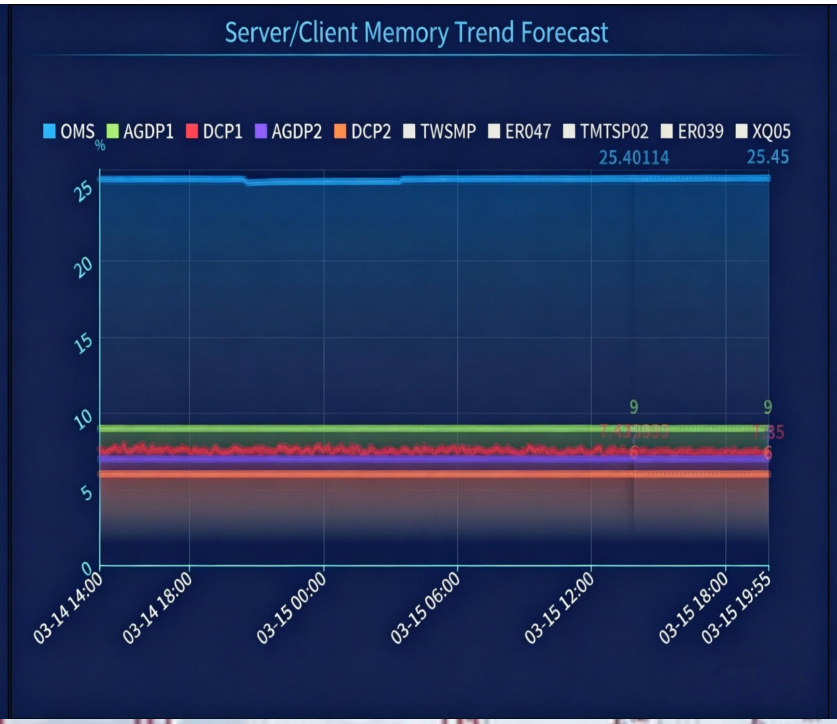
Smartised Maintenance Method Based on Log and Text Analyzing

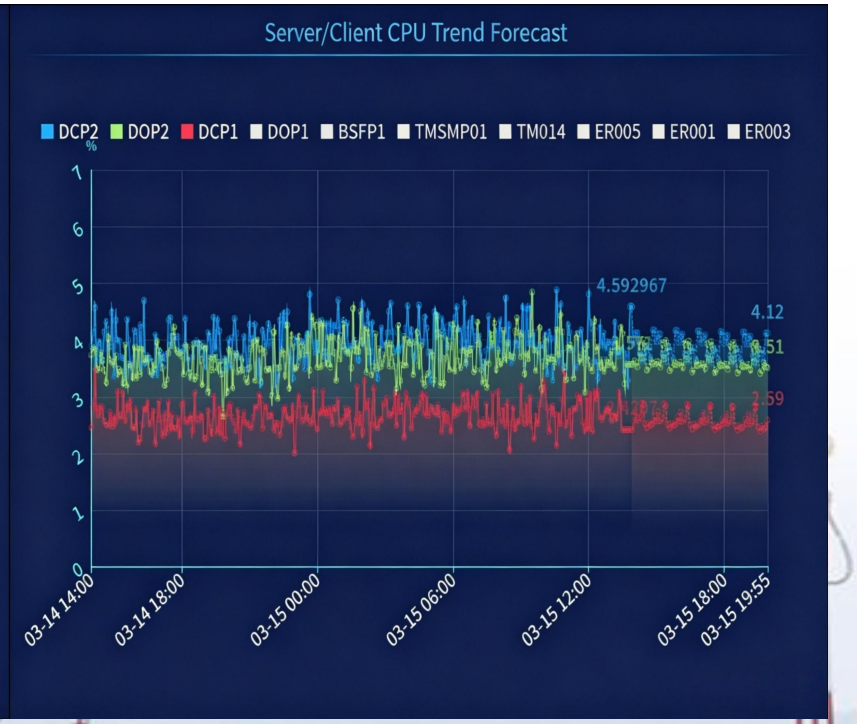
CONTENTS

3.1 Comprehensive Visual Monitoring

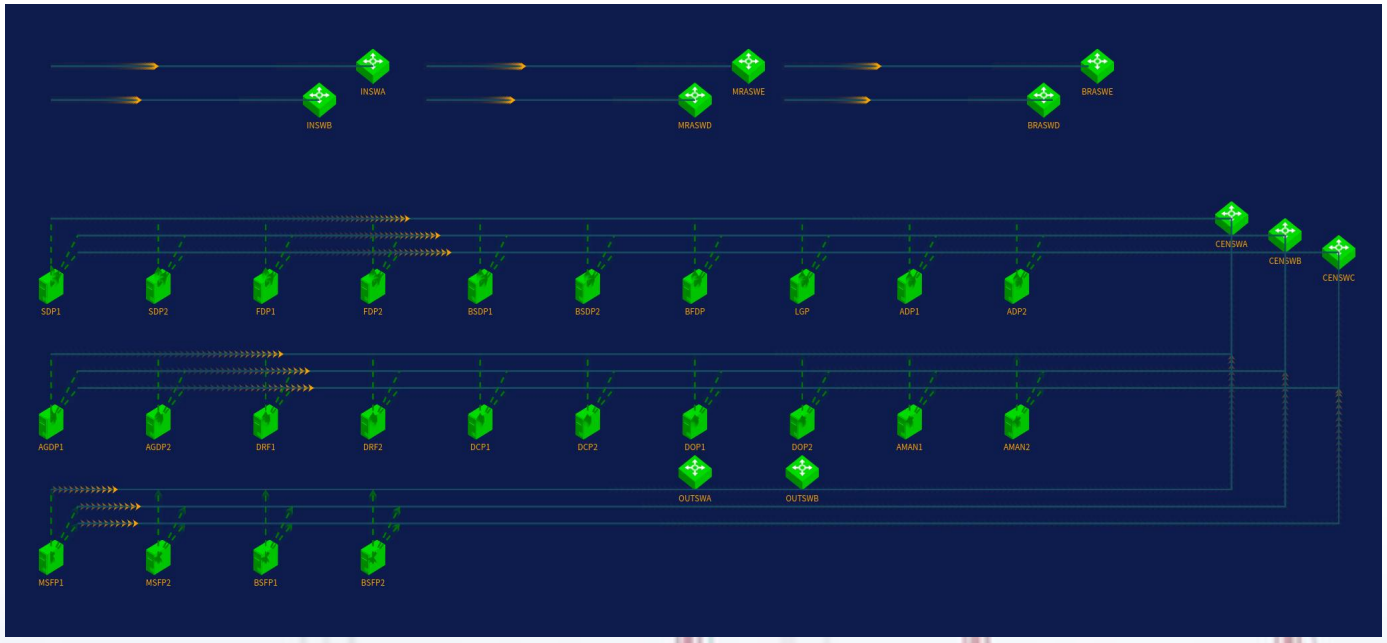
System Overview provides real-time display of key indicators such as CPU load, memory usage , disk usage, and health status for all servers and clients. enabling indicator-ranking and trend predictions.







3.1 Comprehensive Visual Monitoring



Topology dynamic presentation, which displays the real-time communication status of servers, network devices, and logical links through dynamic network topology diagrams. It supports visual switch from the topology diagram to device details, achieving control of the entire system's links.

Device-asset management

3.2 Early Warning and Closed-loop Handling

» 查询 (22)

开始时间 - 结束时间 | 主体 | 预警内容 | 是否确认 | 是否挂起 | 查询 | 导出 | 确认 | 挂起

序号	产生时间	更新时间	预警主体	确认时间	预警内容	等级	是否确认	挂起
1	2025-05-13 07:54:09	2025-05-13 07:54:09	SDP1	2025-05-13 09:23:31	CETC_TEST模块内存使用率呈上升趋势，请予以关注。	中	已确认	
2	2024-01-15 12:38:54	2024-01-15 12:38:54	TM051	2024-09-23 08:27:45	ACEC21上的CETC_POST模块的内存占用率呈现增长趋势。根据回归模型评估，从2024-01-15 00:40:00 到2024-01-15 12:25:00 占用率增长量占全系统内存的0.32%，预计3小时后的增长量将占全系统内存的0.11%.		已确认	
3	2024-01-15 12:38:54	2024-01-15 12:38:54	TM051	2024-09-23 08:27:45	ACEC21上的CETC_SDD模块的内存占用率呈现增长趋势。根据回归模型评估，从2024-01-15 00:40:00 到2024-01-15 12:25:00 占用率增长量占全系统内存的0.16%，预计3小时后的增长量将占全系统内存的0.05%.		已确认	
4	2024-01-15 12:38:54	2024-01-15 12:38:54	TM052	2024-09-23 08:27:45	ACPLC21上的CETC_SDD模块的内存占用率呈现增长趋势。根据回归模型评估，从2024-01-15 00:40:00 到2024-01-15 12:25:00 占用率增长量占全系统内存的0.15%，预计3小时后的增长量将占全系统内存的0.05%.		已确认	
5	2024-01-15 12:38:54	2024-01-15 12:38:54	TM053	2024-09-23 08:27:45	ACEC22上的CETC_POST模块的内存占用率呈现增长趋势。根据回归模型评估，从2024-01-15 00:40:00 到2024-01-15 12:30:00 占用率增长量占全系统内存的0.28%，预计3小时后的增长量将占全系统内存的0.09%.		已确认	
6	2024-01-15 12:38:54	2024-01-15 12:38:54	TM054	2024-09-23 08:27:45	ACPLC22上的CETC_POST模块的内存占用率呈现增长趋势。根据回归模型评估，从2024-01-15 00:40:00 到2024-01-15 12:30:00 占用率增长量占全系统内存的0.31%，预计3小时后的增长量将占全系统内存的0.1%.		已确认	

Early Warning and Closed-loop Handling, based on system data collected already and real-time status, early warning is provided. All the operation of warnings, such as confirmation, suspension, clearance and export, is implemented on the platform.

3.3 Automatic Operation by Smartised Maintenance

Automatic system inspection

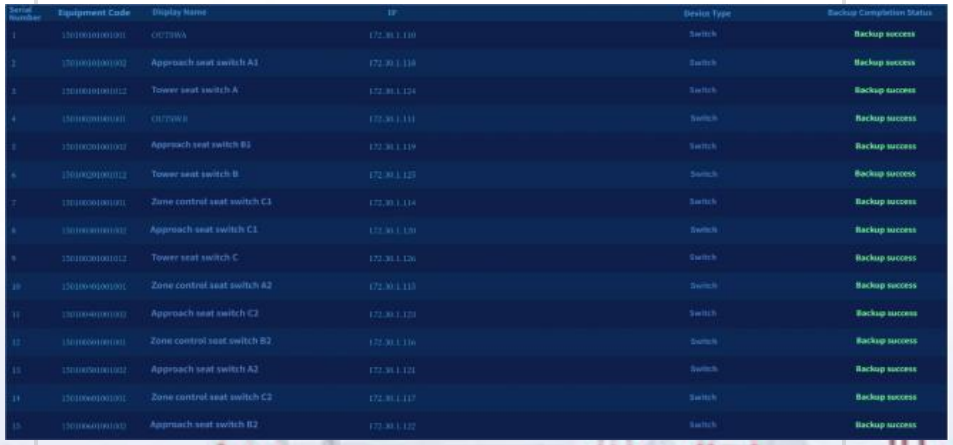
the platform implements automatic inspection, covering server status, client status, link connectivity, database status, and disk health.

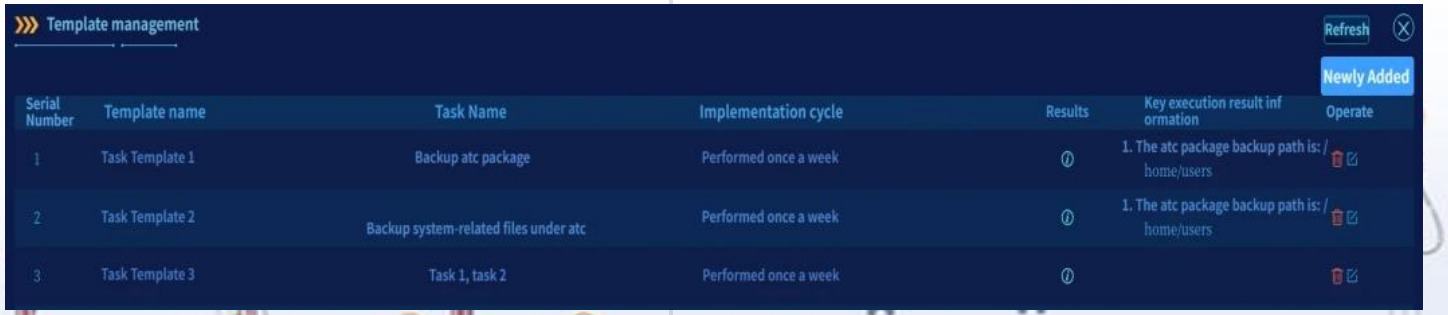
Automatic configuration backup

the platform implements scheduled or manual backup for system configuration files within the system. And all configuration files can be exported easily.

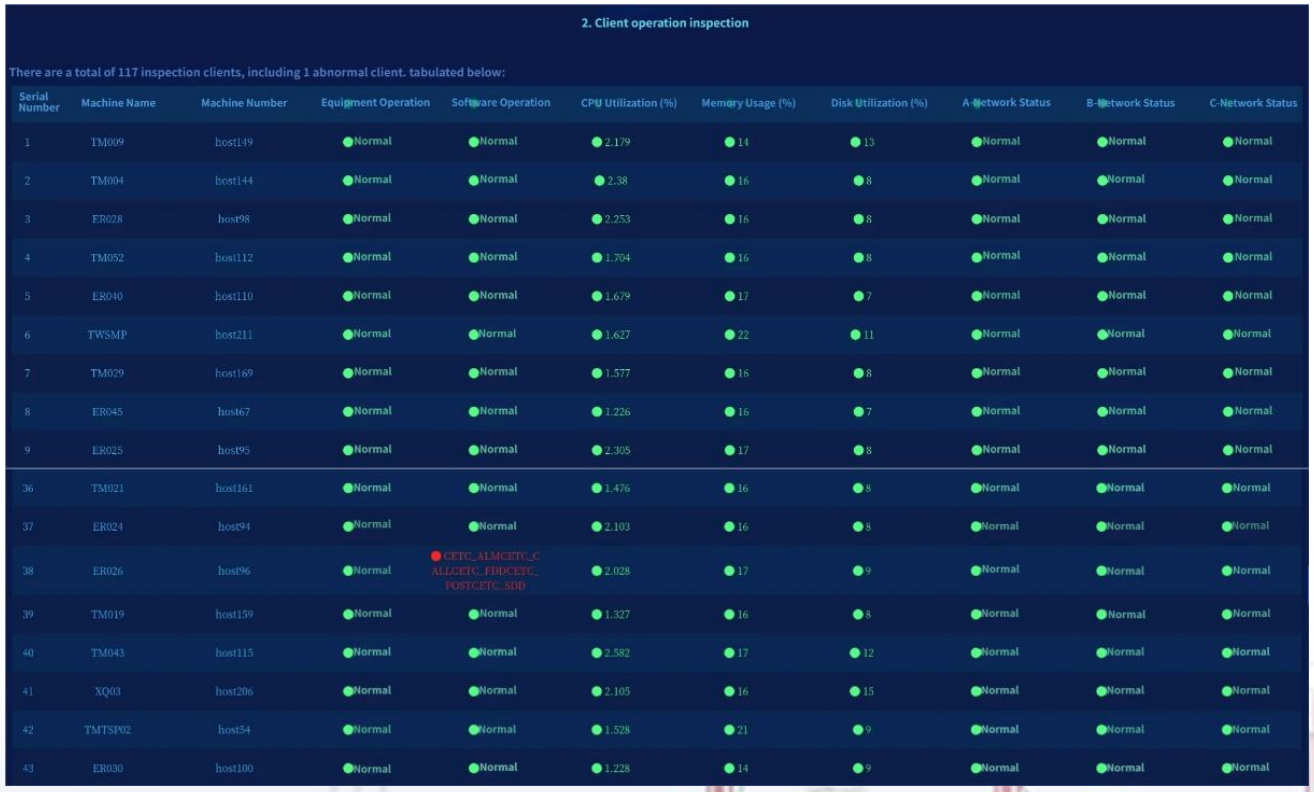
Standardized operations toolkit

the maintenance toolkit includes built-in standardized scripts for software package backup, full-system clock synchronization, database error log inspection, ILO alert log export, etc.





3.3 Automatic Report Creation and Log Management



2. Client operation inspection

There are a total of 117 inspection clients, including 1 abnormal client. tabulated below:

Serial Number	Machine Name	Machine Number	Equipment Operation	Software Operation	CPU Utilization (%)	Memory Usage (%)	Disk Utilization (%)	A-Network Status	B-Network Status	C-Network Status
1	TM009	host149	Normal	Normal	2.179	14	13	Normal	Normal	Normal
2	TM004	host144	Normal	Normal	2.38	16	8	Normal	Normal	Normal
3	ER028	host98	Normal	Normal	2.253	16	8	Normal	Normal	Normal
4	TM052	host112	Normal	Normal	1.704	16	8	Normal	Normal	Normal
5	ER040	host110	Normal	Normal	1.679	17	7	Normal	Normal	Normal
6	TWSMP	host211	Normal	Normal	1.627	22	11	Normal	Normal	Normal
7	TM029	host169	Normal	Normal	1.577	16	8	Normal	Normal	Normal
8	ER045	host67	Normal	Normal	1.226	16	7	Normal	Normal	Normal
9	ER025	host95	Normal	Normal	2.305	17	8	Normal	Normal	Normal
36	TM021	host161	Normal	Normal	1.476	16	8	Normal	Normal	Normal
37	ER024	host94	Normal	Normal	2.103	16	8	Normal	Normal	Normal
38	ER026	host96	Normal	CETC_ALMCETC_CALLCETC_FDDCETC_POSTCETC_SDD	2.028	17	9	Normal	Normal	Normal
39	TM019	host159	Normal	Normal	1.327	16	8	Normal	Normal	Normal
40	TM043	host115	Normal	Normal	2.582	17	12	Normal	Normal	Normal
41	XQ03	host206	Normal	Normal	2.105	16	15	Normal	Normal	Normal
42	TMTSP02	host54	Normal	Normal	1.528	21	9	Normal	Normal	Normal
43	ER030	host100	Normal	Normal	1.228	14	9	Normal	Normal	Normal

Automatic Report Creation: With data collected, a system inspection report on system health can be automatically created. The platform supports cross-device log management, allowing batch-export by time, host, keywords, and other criteria. Problem troubleshooting time is reduced from 60 minutes to within 20 minutes, with efficiency improved.

CONTENTS

04 Experience and Benefits

Standard-based Systematic Plan and Implementation : a systematic project that is planned in accordance with Air Traffic Management Automation Systems

Modular and Scalable Technology Architecture: the strategy of platform plus customized functional modules can still be adopted to assist traditional maintenance

Focus on Data-driven Approach: The key practice of smartised maintenance is to establish a data-driven strategy

Maintenance Powered by AI: In terms of log analysis, AI-powered tools can play an important role. AGI models has the capacity to boost our maintenance capacity.

CONTENTS

Conclusion

Smartised maintenance is an innovative attempt to address the challenges of maintenance on complex systems. These functions can successfully transform the maintenance model from reactive to proactive, and from experience-driven to data-driven, to enhance safety and efficiency .

Subsequently more experimental work will be done on system maintenance. The focus will also be on AGI application and data utilization. And new application on flight plan data, weather data and surveillance data can also be made, aiming to improve efficiency and safety. AGI models will be applied for log and data analysis.

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Thanks!

Looking forward to progress together !