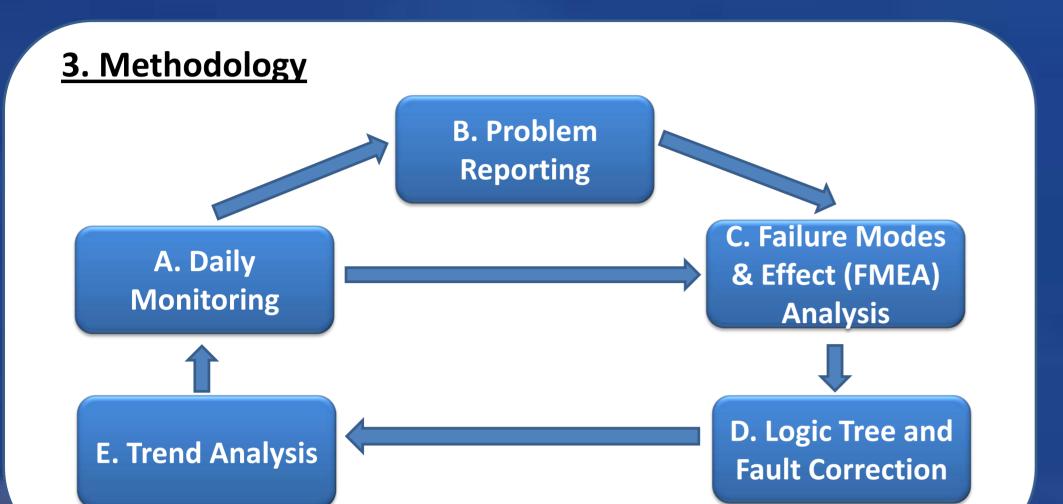
# SDP Project: Reliability Study of Commercial Electrical System



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## **1. Objectives**

The team will look into factors affecting reliability of the electrical systems currently in use by Company Beta. The team will then propose possible precautionary measures in addressing some of the critical failure modes



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Fault\_4 Fault\_5 Fault\_6

'ault\_7 'ault\_8

ault\_9

Fault\_10 Fault\_11

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problems earlier before they can become critical

**2. Problem Description** 

### Fig A.1 Automated Pivot Table Generation

### **3A. Daily Monitoring**

Standardize Valid Entry in Dropdown List to minimize human Error
Enable the function to modify valid entries and automatically map fault type and fault category to avoid inconsistent definition

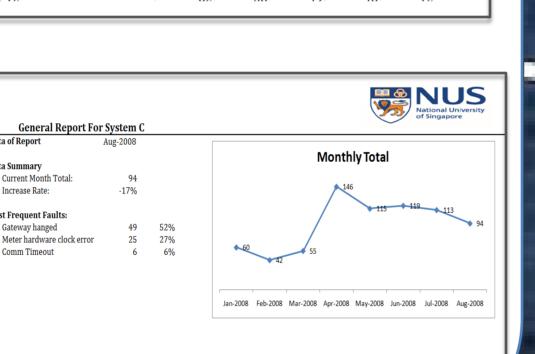
• Use VBA to automate Pivot table generation

 Construct Exponentially Weighted Moving Average (EWMA) Chart to monitor monthly fault rate

### **3B. Problem Reporting**

- Automatically raise red flag when the monthly fault rate exceeds the control limit
- Identify critical fault type for investigation
- Calls to attention for fault type with increasing fault rate
- Suggest remedial actions for critical fault type

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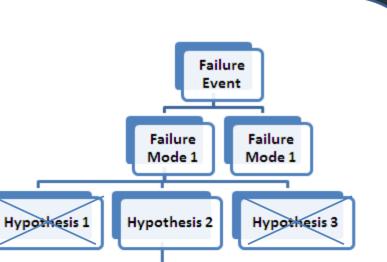


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Fig B.1 VBA Display for Problem Reporting (Data is disguised, for illustration purpose only)

### **3D. Logic Tree and Fault Correction**

- All hypotheses are supported with data collected in the categories of parts, position, people, paper and paradigms
- Maintain a verification log on a continuing basis to document supporting data



Physical Root

Cause

Human

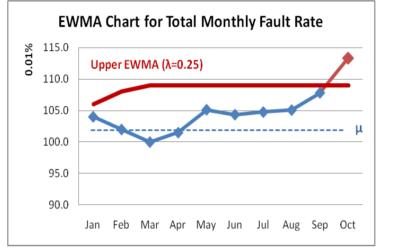
Root

Cause

Latend

Root

Cause



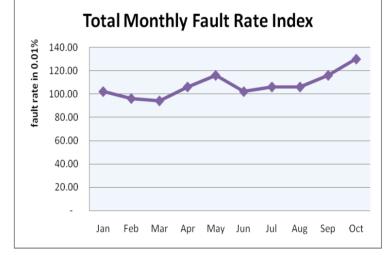


Fig A.2 VBA Display for daily monitoring ( Data is disguised, for illustration purpose only)

We propose to improve on the existing system by adopting monitoring

measures such as trend analysis and control charting to spot and address

### 3C. Failure Mode & Effect Analysis (FMEA)

Build FMEA as a periodical record on the electrical systems in service
Once an incident occurs, FMEA table is used as the first step in Root Cause Analysis to identify the most likely root causes

Subsystem	Mode	Effect on Entire System	Severity (1-10)	Probability (0-1)	Critical
	Mode 1	Effect 1	9	0.0002	0.0018
	Mode 2	Effect 2	1	0.0010	0.001
	Mode 3	Effect 3	8	0.0007	0.0056
	Mode 4	Effect 4	4	0.0020	0.008
	Mode 5	Effect 2	9	0.0026	0.0234
Cuberrate 1	Mode 6	Effect 3	9	0.0020	0.018
Subsystem 1	Mode 7	Effect 4	4	0.0012	0.0048
	Mode 8	Effect 4	9	0.0008	0.0072
	Mode 9	Effect 4	5	0.0002	0.001
	Mode 10	Effect 2	3	0.0014	0.0042
	Mode 11	Effect 4	8	0.0307	0.2456
	Mode 12	Effect 4	9	0.0022	0.0198
	Mode 13	Effect 4	2	0.0060	0.012
	Mode 14	Effect 4	9	0.0100	0.09
Subsystem 2	Mode 15	Effect 2	2	0.0230	0.046
	Mode 16	Effect 4	4	0.0089	0.0356
	Mode 17	Effect 4	6	0.0087	0.0522
	Mode 18	Effect 3	4	0.0028	0.0112
Subsystem 3	Mode 19	Effect 4	1	0.0392	0.0392

Identify possible faulty subsystems based on previous full FMEA table, and hence within a short time, time and effort can be allocated to those failure modes under
Subsystems with a relatively high probability of being the root cause of the problem.

Fig C.1 FMEA Table (Data is disguised, for illustration purpose only)

### **3E. Trend Analysis**

• Remove Critical Fault type to obtain the base line fault rate

- Identify Root Cause at Physical, Human and Latent level
- Learn from root cause to improve daily operation
- Provide basis for fault correction

Fig D.1 Logic Tree

# 4. Conclusion

- A rigorous framework to effectively identify critical faults
   Qualitative Solution: Logic Tree
  - •Quantitative Solution: FMEA Analysis, Trend Analysis
- VBA Tools developed to aid daily monitoring and problem reporting
- Proposed Power Law Process for future reliability study of repairable systems



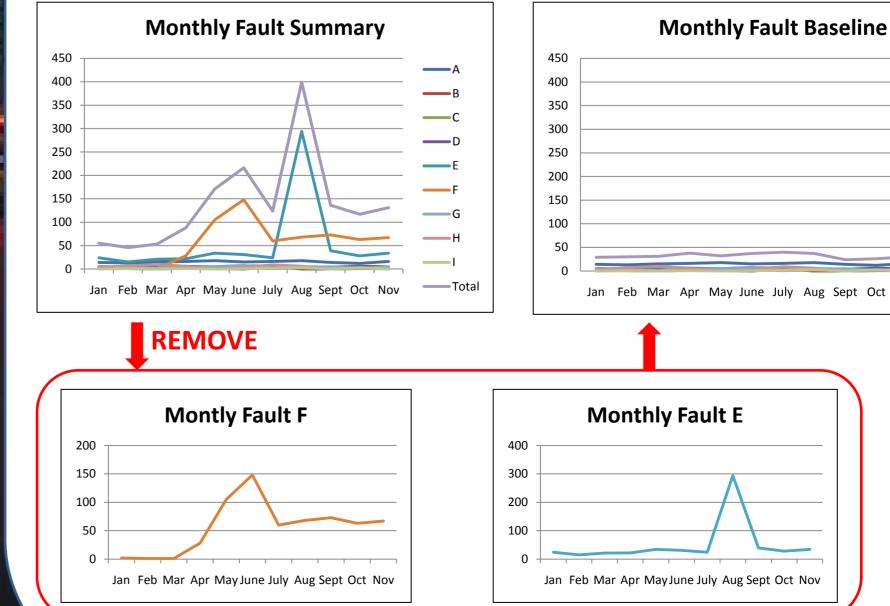


Fig E.1 Graphs of Trend Analysis ( Data is disguised, for illustration purpose only)