

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

2. Problem Description

We propose to improve on the existing system by adopting monitoring measures such as trend analysis and control charting to spot and address problems earlier before they can become critical

3. Methodology



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

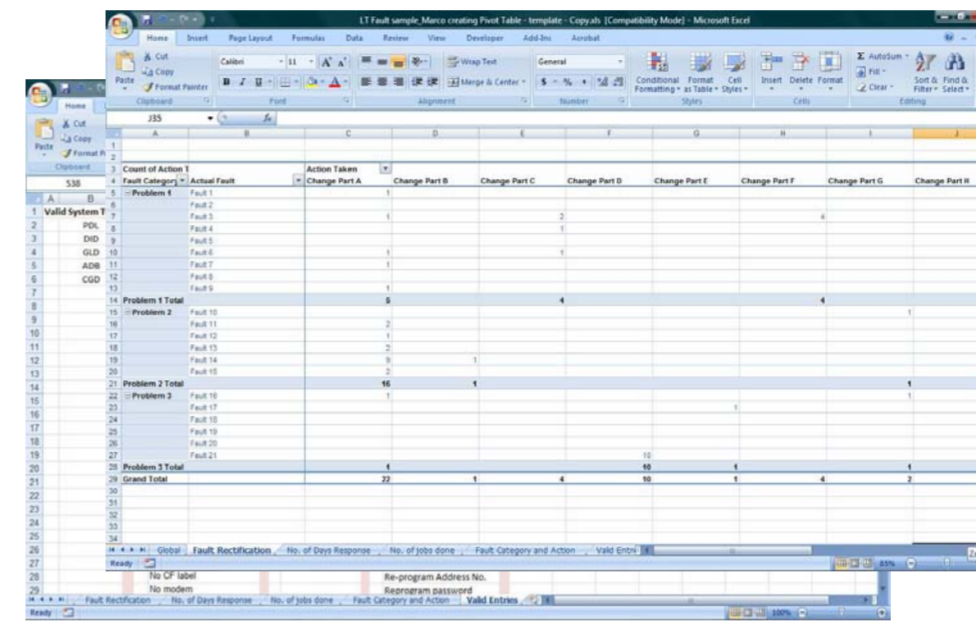


Fig A.1 Automated Pivot Table Generation

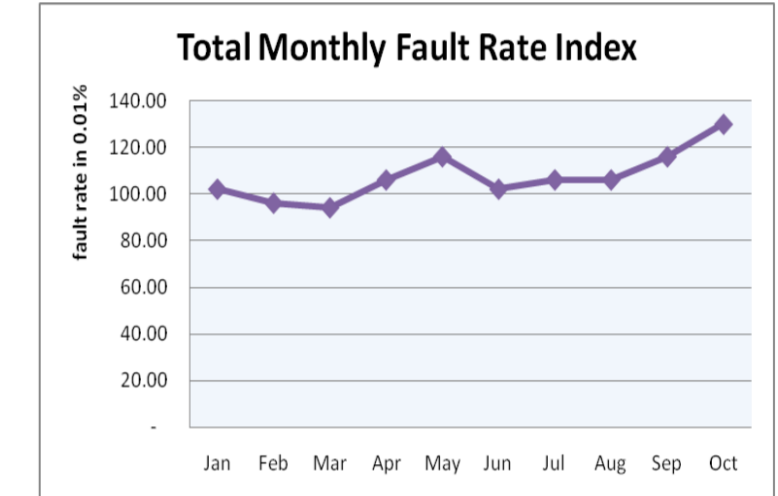
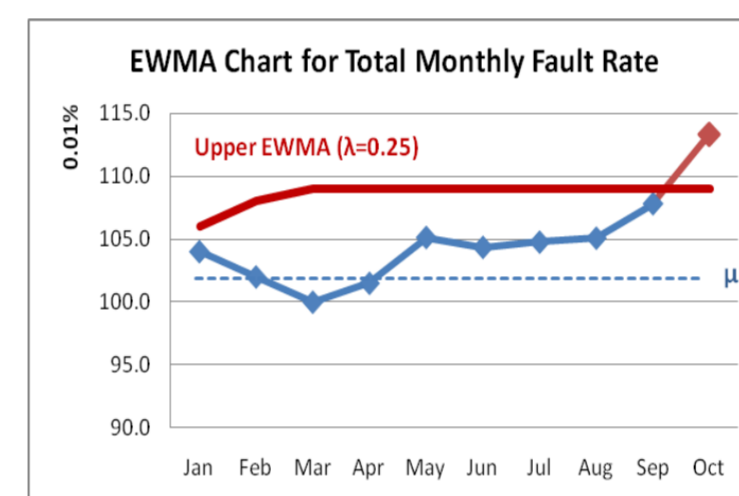


Fig A.2 VBA Display for daily monitoring (Data is disguised, for illustration purpose only)

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

Monthly Summary Report of: Oct-2008	Electrical Systems				
Fault Type	A	B	C	D	E
Fault_1	63	7	44	10	9
Fault_2	38	97	92	8	30
Fault_3	34	14	56	36	70
Fault_4	61	53	42	68	22
Fault_5	62	66	60	6	39
Fault_6	2	2	62	30	19
Fault_7	13	43	100	15	79
Fault_8	45	12	87	43	7
Fault_9	54	95	34	98	37
Fault_10	18	53	11	9	58
Fault_11	26	39	37	26	96
Fault_12	62	38	49	48	12

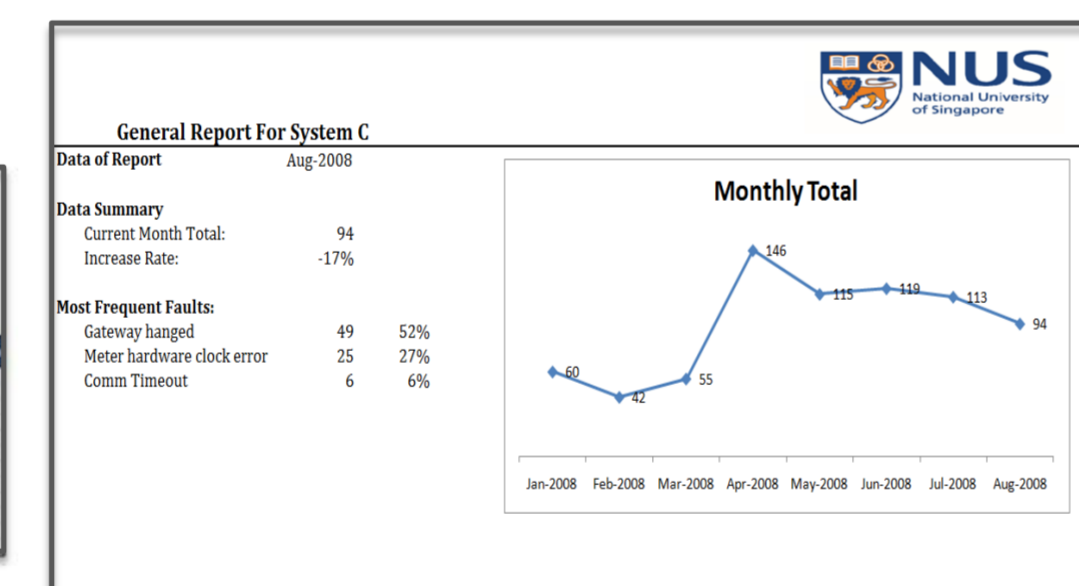


Fig B.1 VBA Display for Problem Reporting (Data is disguised, for illustration purpose only)

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
Subsystem 1	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
	Mode 6	Effect 3	9	0.0020	0.018
	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
Subsystem 2	Mode 13	Effect 4	2	0.0060	0.012
	Mode 14	Effect 4	9	0.0100	0.09
	Mode 15	Effect 2	2	0.0230	0.046
	Mode 16	Effect 4	4	0.0089	0.0356
Subsystem 3	Mode 17	Effect 4	6	0.0087	0.0522
	Mode 18	Effect 3	4	0.0028	0.0112
	Mode 19	Effect 4	1	0.0392	0.0392

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

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

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

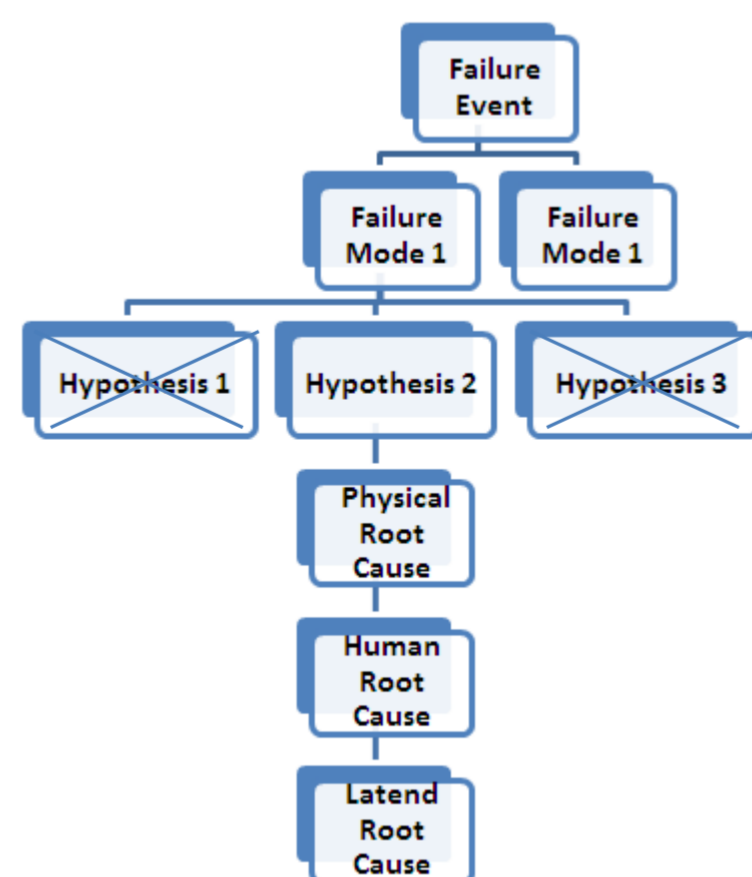


Fig D.1 Logic Tree

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

3E. Trend Analysis

- Remove Critical Fault type to obtain the base line fault rate
- Audit the effectiveness of fault rectification and correction

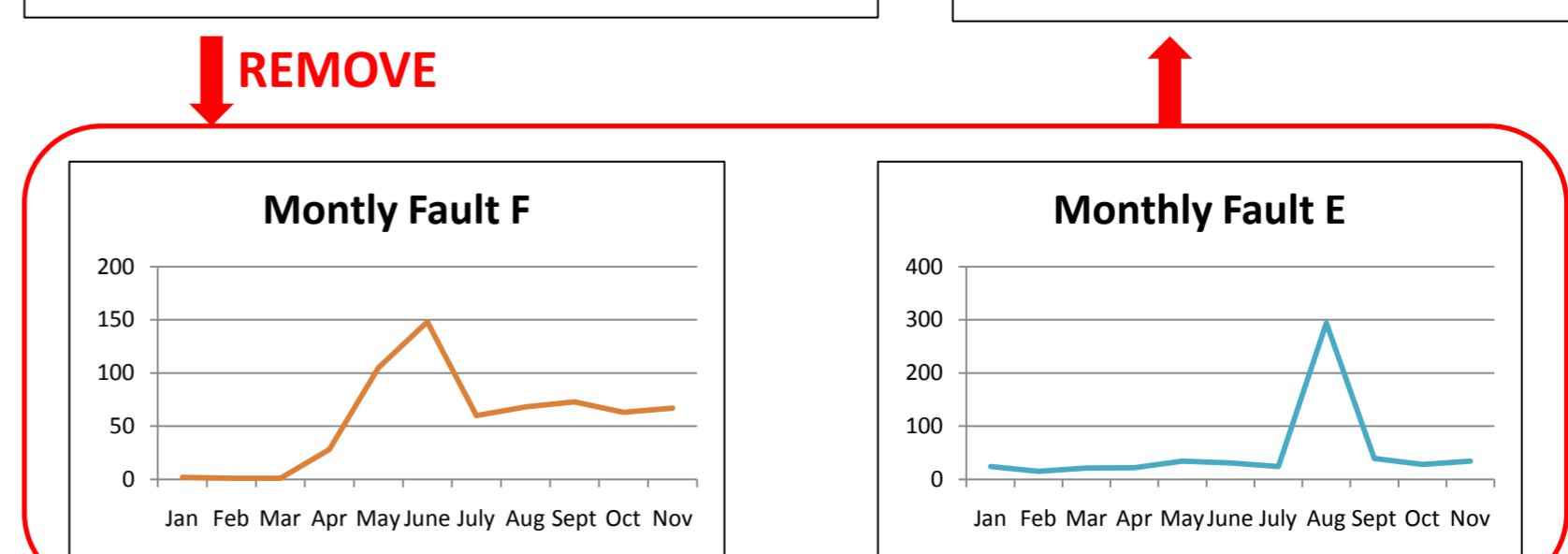
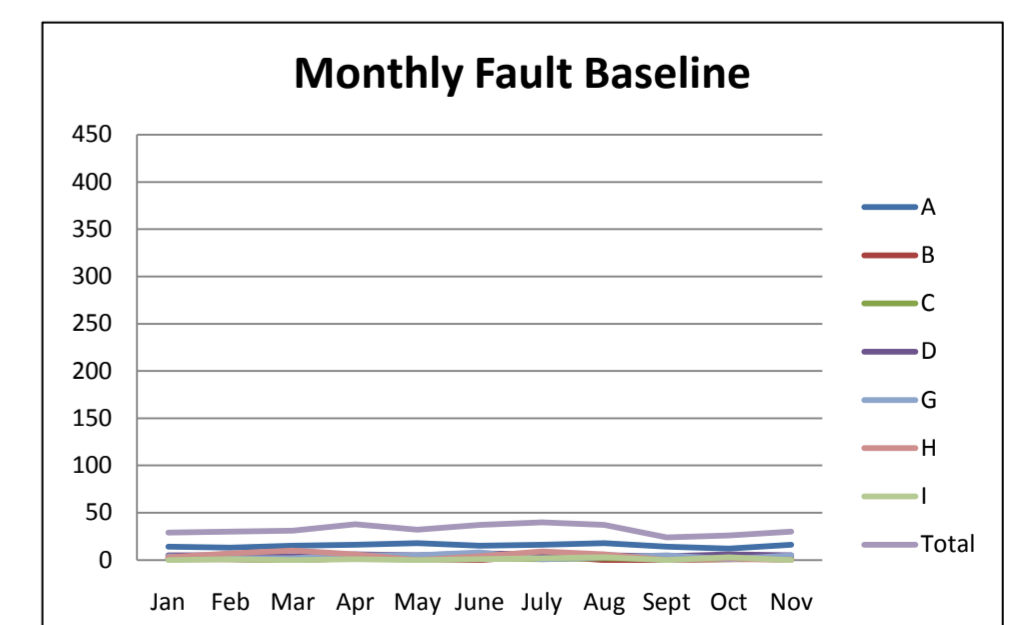
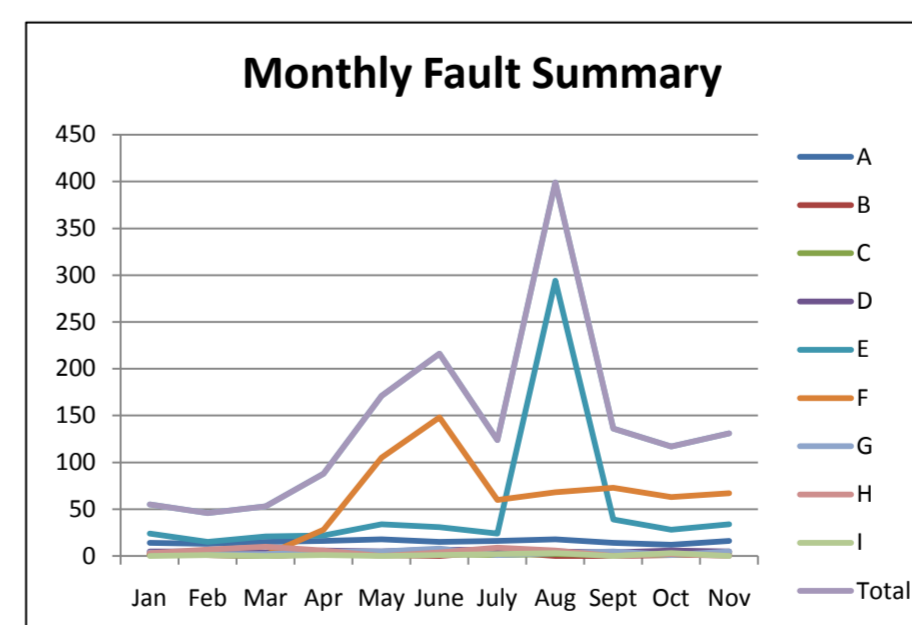


Fig E.1 Graphs of Trend Analysis (Data is disguised, for illustration purpose only)