Department of Industrial and Systems Engineering – IE3100R Systems Design Project

Enhancing Engineers' Productivity Through Process Refinement

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Background

SIAEC is a subsidiary company under Singapore Airlines, specializing in aviation maintenance, repair and overhaul (MRO). It serves over 80 international airlines through a global network of 26 joint ventures and subsidiaries across nine countries. Our group has worked with SIAEC for the past nine months to provide solutions to improve the productivity of the company.

Problems

SIAEC aims to stay ahead of competition in the MRO industry by improving its internal operations, in a bid to reduce redundant or inefficient work processes and thereby save time and costs.

Objectives

Trigger → Analysis → Recommendation

A defect analysis process can be divided into the above ***3 stages***. They will be targeted with the ultimate aim of increasing engineering productivity through the objectives below

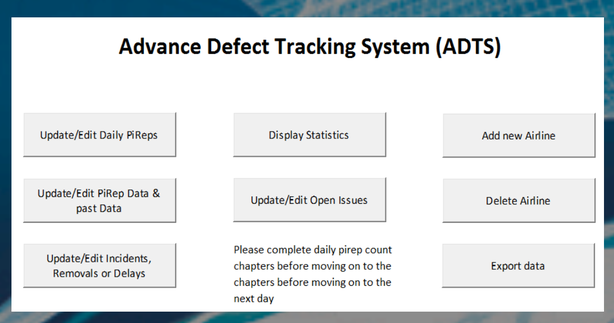
1. Implementing **early detection of defects** so as to reduce lead time of engineers in identifying the defects to be reflected in reliability reports.
2. **Integrating fragmented data sources** from which engineers access regularly for supporting statistics and documents
3. Introducing a **Standard Operating Procedure** for engineers to narrow down the list of remedies possibly required when encountered with technical issues

Solution 1

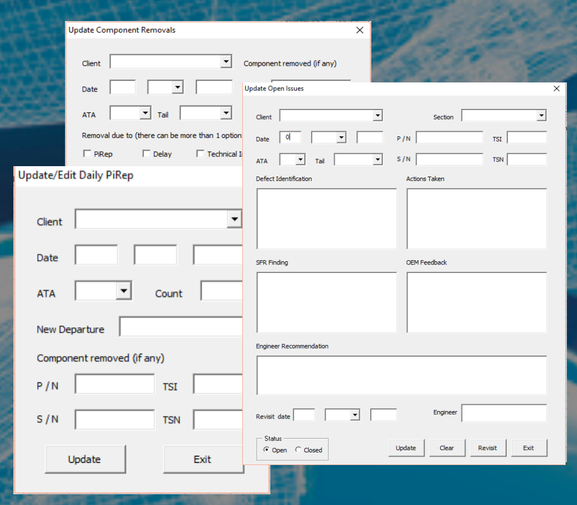
Advance Defect Tracking System (ADTS)

Monitors and forecasts the rates of occurrences of defect indicators in real time, allowing engineers to start work promptly. Also, this platform enables the engineers to extract available data directly to perform defect troubleshooting. The system is designed in Excel VBA.

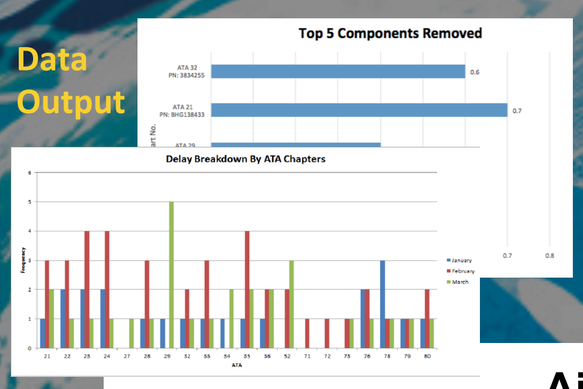
User Functions



User Interface



Data Output



Color coding is applied on all reliability indicators to signal if they have exceeded(red) or are approaching (yellow) threshold values

Sunday, 20 Feb 2016

Airline A

Pirep

ATA	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	38	46	49	51	52	53	54	55	56	57	71	72	73	74	75	76	77	78	79	80
Threshold	3.29	0.32	4.19	0.64	1.52	1.2	0.62	0.35	0.29	1.58	10.2	1.83	6.35	1.53	0.38	0.58	0.92	0.21	0.58	0.24	0	0.03	0.1	0.03	0	0	0.43	0.77	0	0	0.03	0.14	0.13	0.19	0	0
Dec-15	1.2	1.1	2.2	0.12	0.17	0.5	0.6	0.4	0.7	0.14	0.15	1.17	9.15	2.15	11	0.17	0.3	0.8	0	0.3	0	0	0	0.1	0	0	0	0	0.2	0.2	0	0	0	0	0.1	0.2
Jan-16	2	0.8	2.21	0.13	0.18	0.5	0.6	0.4	0.7	0.15	0.16	1.18	9.16	2.16	12	0.18	0.3	0.8	0	0.3	0	0	0	0.1	0	0	0	0	0.2	0.2	0	0	0	0	0.1	0.2
Feb-16	1.1	1.2	2.16	0.8	0.13	0.5	0.6	0.4	0.7	0.1	0.11	1.13	9.11	2.11	7	0.13	0.3	0.8	0	0.3	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0.1	0.2
Predicted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

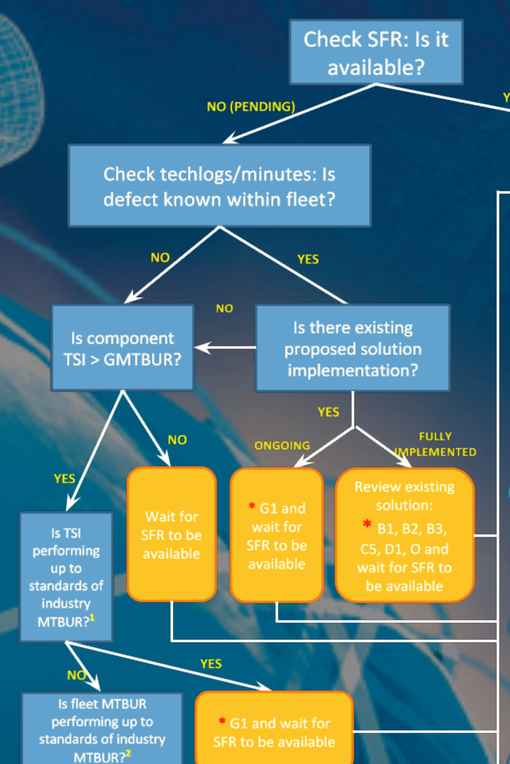
ATA	Tail	P/N	S/N	TSI	TSN	Delay Duration	Defect / Rectification	Trigger	Status
34	MGH-999	435456787	6754224			21	VENT SKIN INLET VALVE WITH XX INDICATION ON PRESS. PAGE	TI	Open
43	MGH-999	823547408	6966542			5	DURING PRE DEPARTURE PACK MEASUREMENT ON ECAM	TI	Closed
21	MGI-777	679347437	2346665				AVNCS VENT INOP SYSTEM	TI	Open
72	MGH-999	988654323	7963552	10	5	35	PACK 1 REG FAULT RECURRING DURING FLT INDICATION ON THE BLEED	PiRep TI	Open

Solution 2

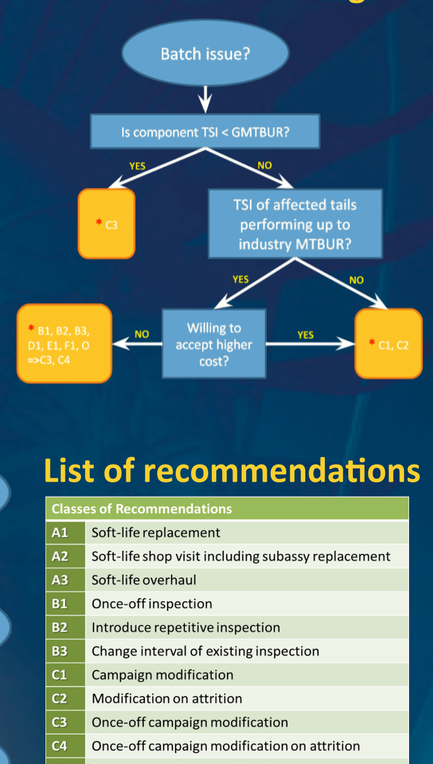
Decision Tree

Standardizes the procedure through which the engineers arrive at a predetermined set of general recommendations. Depending on the available data, the tree requests for different information and the engineer's input. The tree follows a flowchart logic of which part of it is shown below. This tree is implemented through Excel VBA to enhance the usability.

Main Tree Logic



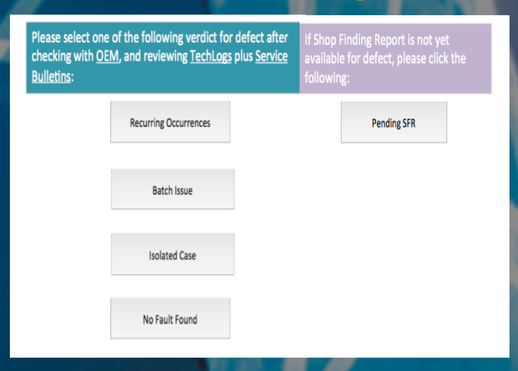
1 of the Sub Tree Logic

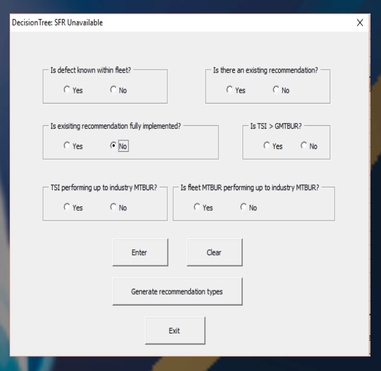


List of recommendations

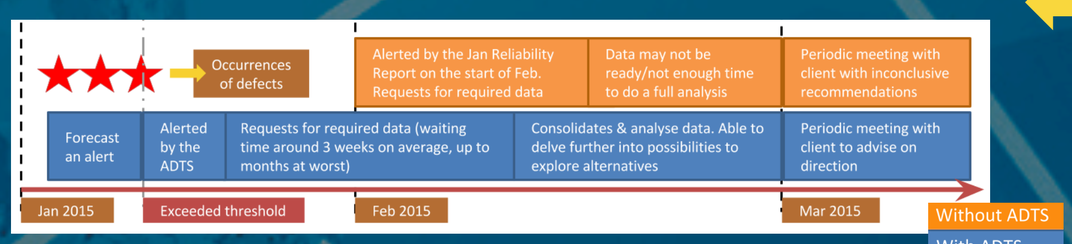
Classes of Recommendations	
A1	Soft-life replacement
A2	Soft-life shop visit including subassy replacement
A3	Soft-life overhaul
B1	Once-off inspection
B2	Introduce repetitive inspection
B3	Change interval of existing inspection
C1	Campaign modification
C2	Modification on attrition
C3	Once-off campaign modification
C4	Once-off campaign modification on attrition
C5	Revert to previous modification
D1	Revision of manual to include notes/issues/memo
E1	Adjustment/rigging to newly specified values
F1	Change interval of existing maintenance tasks
G1	Do nothing
O	Some form of appropriate analysis/test to determine new values

Digitalized Version





Quantification of Results



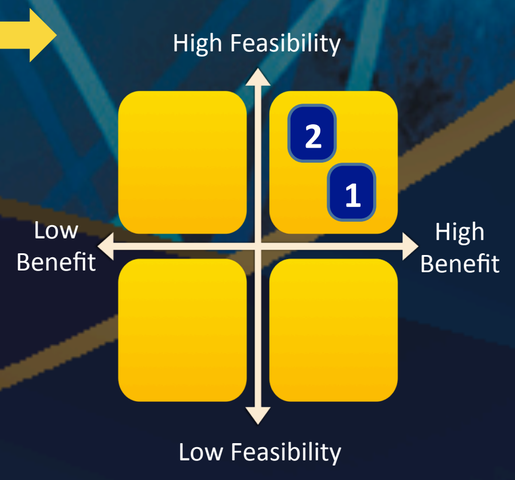
With ADTS in place, engineers are able to begin in-depth analysis once threshold exceedance has been forecasted. This enables engineers to have more time to provide comprehensive recommendations for their clients earlier, increasing their productivity.

The decision tree streamlines the thought and analysis processes of engineers to allow for more efficient and precise decisions to be made.

Our solutions will induce cost savings through the prevention of potential flight delays. This is shown below using Airline A's ongoing history of 0.6 technical delays per 100 revenue flights and industrial figures provided by our advisors:

Average number of revenue flights per month	2929		
Average number of delays per month	17.574		
Proportion of delays prevented by ADTS	20%		
Delay duration	<= 90 mins	> 90 mins	
Average cost of a delay	17,000	23,000	
Probability of a delay	0.75	0.25	
Number of delays prevented per month	0.8787	2.6361	Total
Cost saved from delay	20210.1	44813.7	65023.8

Conclusion



Evaluating the solutions, both solutions will yield high benefits and feasibility.

Solution 1 reaps high benefits but is difficult to fully implement as it requires a high level of integrality with the current SIAEC work process.

Solution 2 helps further increase an engineer's productivity and is easier to implement.