

# Enhancing Safety of Helicopter Fleets Through the Use of Software to Monitor Lubricated Systems

Peter Kasten<sup>1</sup>, Neill Phillips<sup>2</sup>

<sup>1</sup> *Sales & Marketing, Dingo Maintenance Systems, PO Box 1203, Toowong, Queensland, 4066, Australia*

<sup>2</sup> *Engineering Services, Dingo Maintenance Systems, PO Box 1203, Toowong, Queensland, 4066, Australia*

**Summary:** The Royal Australian Navy and Royal Australian Army implemented new software systems in 2004 to enhance the management of safety for their Seahawk, Seasprite, Sea King and Chinook helicopter fleets. The focus for both organisations was to enhance the method of receiving, analysing and reporting lubrication condition test-results. Existing methods were viewed as too slow, dependent on a single person and subject to software glitches such as (a) loss of data and (b) difficulty in managing component moves between aircraft frames. This paper documents the circumstances that existed, the improvements required and the solution implemented.

**Keywords:** Condition Monitoring, Software, Safety, Lubrication, Oil, Defence Force, Component Management, Remote Data Access

## Introduction

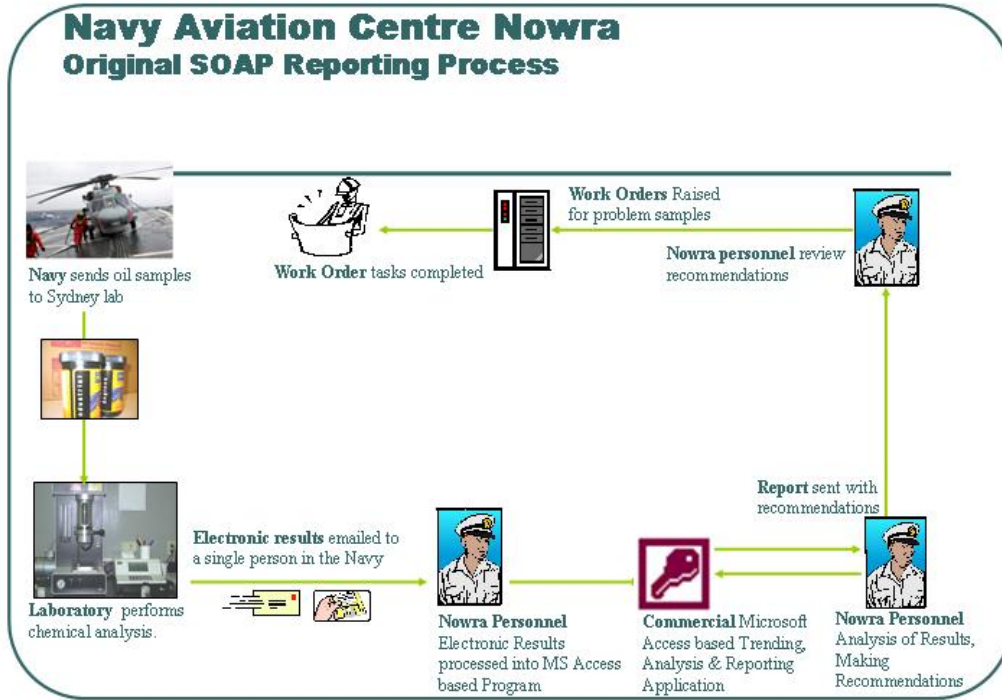
The Royal Australian Navy and Royal Australian Army deploy helicopters within Australia and internationally for humanitarian or military operations. Helicopter crews rely on each organisations condition monitoring experts to clear the aircraft as safe to fly.

In the first half of 2004, both organisations were using different software systems to monitor and assess lubricated component condition. However, Condition Monitoring personnel in both organisations wanted to quicken the speed at which component assessment could be undertaken and improve the integrity of the data. Both organisations at different times in 2004 sought out a solution that would provide them with their existing capabilities but dealt with the primary issues of speed and data integrity.

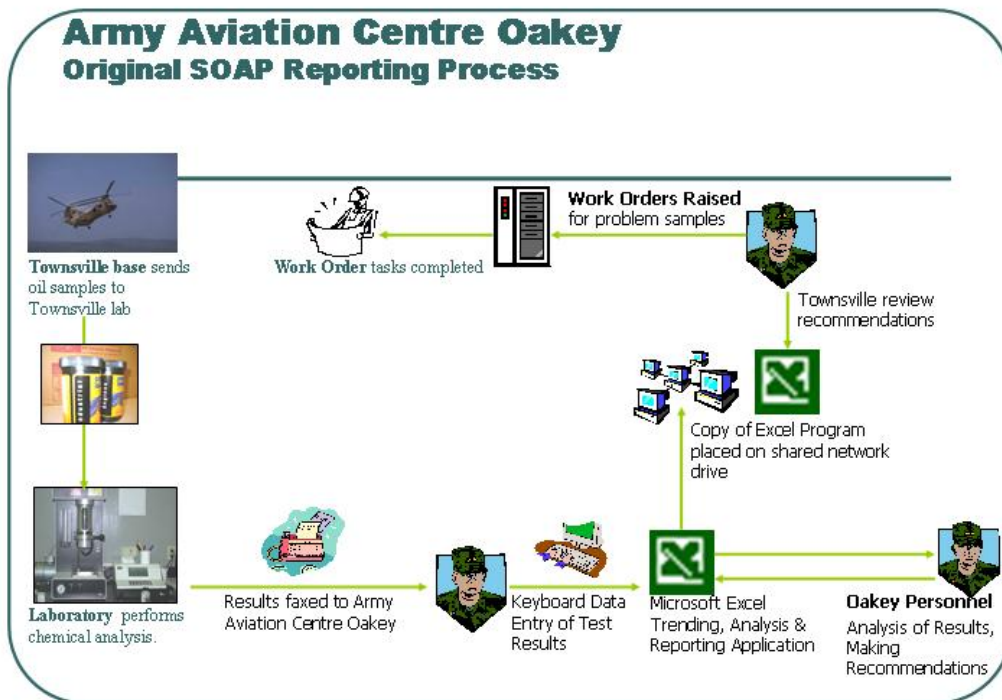
## Existing Systems and Capabilities

Assessment of a lubricated components condition in the first half of 2004 followed the processes detailed in Figures 1 (Navy) and 2 (Army).

The Royal Australian Navy was using a Microsoft Access based commercial software program while the Royal Australian Army was using a macro driven Excel program developed by the Defence Science and Technology Organisation.



*Figure 1: Royal Australian Navy Original SOAP Process Flow*



*Figure 2: Royal Australian Army Original SOAP Process Flow*

## **Key Capabilities**

Both systems had the following capabilities

1. Input of lubricant samples test results
2. Creation, modification and deletion of rules at which point an alarm should be raised
3. Alarm generation when lubricant test results exceed rules set
4. Aircraft frame and component creation, modification and deletion
5. Ability to move components between aircraft frames
6. Graphical trending
7. Basic reporting capabilities

Capabilities unique to the Navy's application were:

- Electronic input of lubrication results (Manually controlled)

Capabilities unique to the Army's application were:

- Ability to view and print alarm levels on graphs and reports.

## **The Key Issues**

### **Overview**

The existing software applications had the primary functions for assessing a component's condition. However, the applications had a number of issues that compromised the speed of the component interpretation process and the accuracy of the interpretation. The issues had the potential to impact on aircraft and crew safety.

### **Single Point of Failure**

The existing applications relied on a single person in the Army or Navy to receive lubricant test-result data via email or fax and then enter the information into the relevant software application. Rarely would other personnel read in sample test results when these individuals were away through illness, training or other duties. Preventable component failure through lack of timely review of condition monitoring data was a risk for both organisations

### **Managing Component Moves and Data Integrity**

Within both applications, manual movement of historical test result data was required when movement of a component to maintenance, or to another airframe occurred. This was a specialised task, and introduced many issues, including:

- Time taken to do the move,
- Risk of damaging/losing/corrupting data during the move,
- Risk of forgetting to move the data at all.

In some instances, the historical information was lost. Inaccuracy and/or loss of data compromised the ability of condition monitoring personnel to assess a components condition. Preventable component failure through a lack of data integrity was a risk for both organisations.

## **Ease of Use**

Both software applications had aspects that made them difficult to use. Examples were:

- Graphs only displayed 1 predictor per graph which made correlation of related predictors, for example silicon and aluminium (dirt entry), cumbersome.
- Creating, modifying and deleting condition monitoring rules was long, tedious and prone to mistakes.
- Producing graphs for condition summary reports involved the cut and paste from the application to a condition report template.

## **Organisation Goals**

The Royal Australian Army and Navy in part through the use of condition monitoring processes and systems has the business objective of maximising the availability of its helicopter fleets while not comprising personnel safety. Existing lubrication condition monitoring software applications had the potential to undermine the organisations capability to deliver on this objective.

## **The Solution**

### **Overview**

The Royal Australian Navy and Army wanted a solution that provided them at a minimum with their existing capabilities and preferably enhanced them. In addition, a solution was required that had the capability to manage the issues of ease of use and data integrity. The Royal Australian Army wanted the issue of single point of failure addressed while the Royal Australian Navy decided that this was not an immediate priority.

Figure 3 shows the solution that met the Royal Australian Army's requirements. Dingo MaintenanceGuy™ was selected to manage the single point of failure issue while Dingo FleetOil™ was selected because it met and exceeded existing software capabilities, managed component moves, data integrity and was easy to use.

### **Management of the Key Issues**

#### *Single Point of Failure*

Figure 3 is the process implemented for the Royal Australian Army. The figure shows the automatic processing of test results sent from the testing laboratory via email by Dingo's MaintenanceGuy™ application. On processing of the test results, MaintenanceGuy™ sends 2 separate emails to 2 groups of people.

The first email shown in Figure 4 is a summary email that MaintenanceGuy™ sends automatically to people who need notification of a components condition. Eight personnel receive the email. The Army elected to inform operational and condition monitoring personnel simultaneously of the laboratories component condition assessment. The new process is a departure from the previous practice of having condition-monitoring personnel first assess a components condition and then inform operational personnel of their assessment. It was felt that this was beneficial, due to operational issues, where condition-monitoring

personnel may be unable to assess a component's condition for periods of up to 2 weeks. Operational personnel now have instant automated information that enables them to make a quick decision on grounding an aircraft when condition monitoring personnel are unavailable.

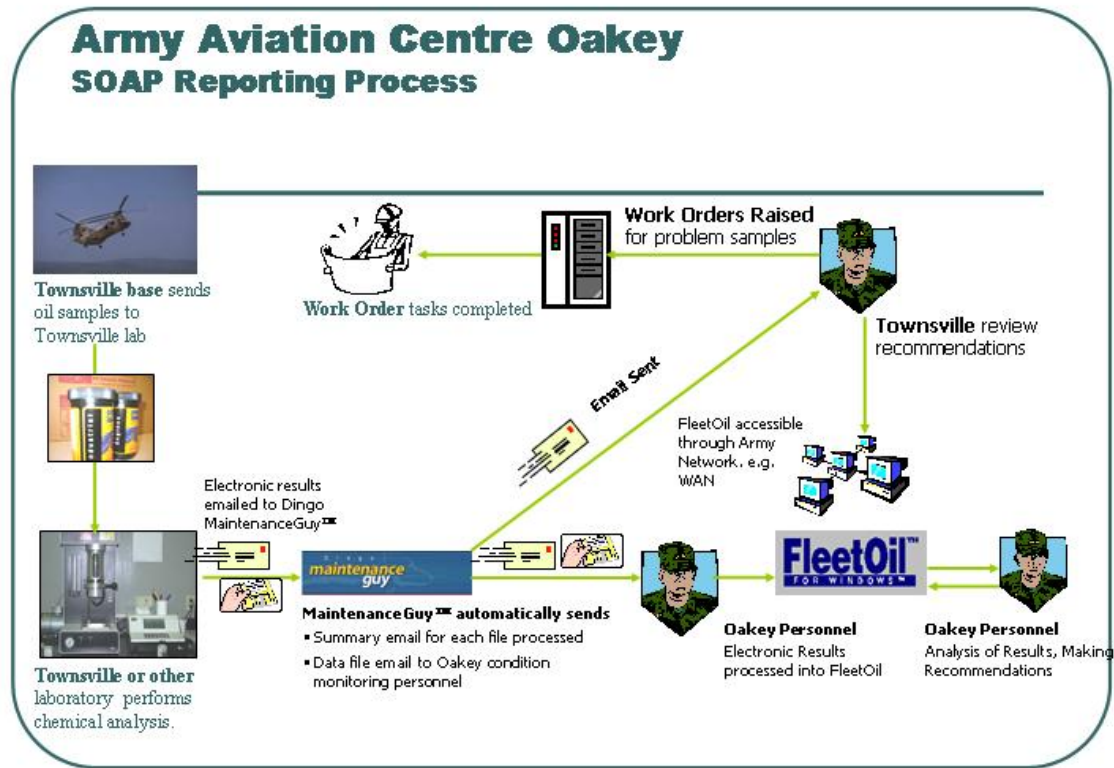


Figure 3: SOAP Process Implemented by Royal Australian Army.

**Note:** The Royal Australian Navy implementation excluded the use of MaintenanceGuy™

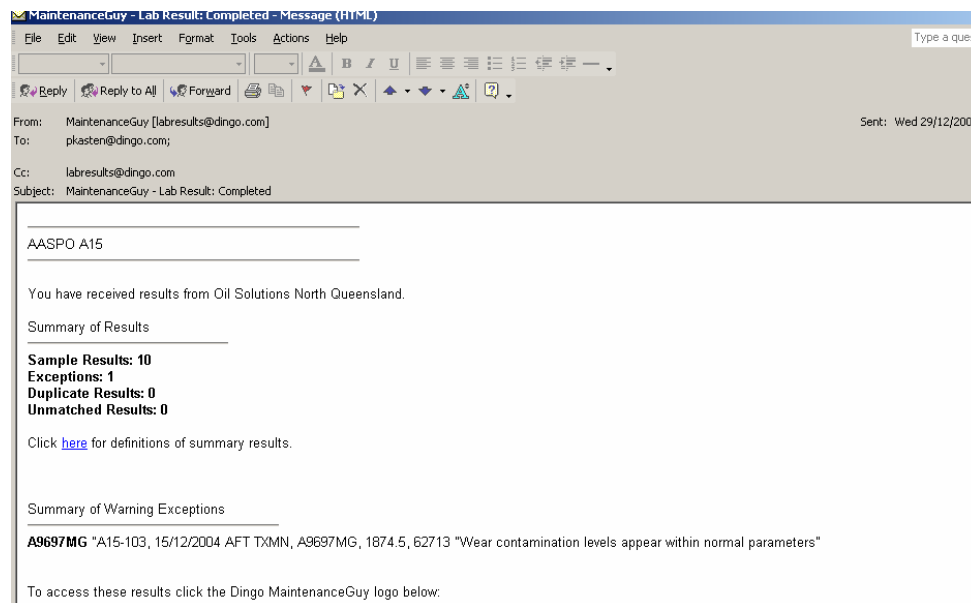
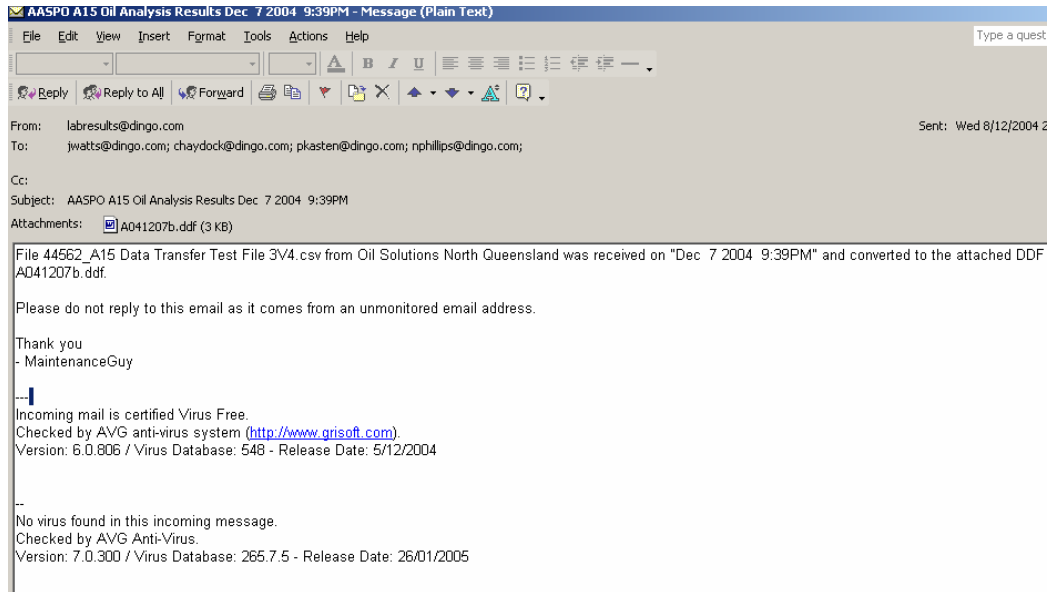


Figure 4: Dingo MaintenanceGuy™ Summary Email

The 2<sup>nd</sup> email shown in Figure 5 is sent to four condition monitoring personnel and contains the laboratory oil test results in electronic format for reading into the Dingo FleetOil™ software program. Only one person is responsible for the reading in of results into FleetOil™ but it was felt that having 3 other people receive the same email increased the likelihood that the condition assessment process would be managed quickly and effectively even when the primary assessor was unavailable.



*Figure 5: Dingo MaintenanceGuy™ Automated Email with electronic oil sample results attached.*

### *Managing Component Moves & Data Integrity*

In Dingo FleetOil™, a component and all of its preceding history can be moved in a simple single operation (<10 keystrokes). The data remains consistent and the lab data intuitively follows the component to the new location. The data also remains healthy and ready for use while a component is sitting in an unused maintenance area. Figure 6 shows the Equipment Details form in FleetOil™ with the *Principal Equipment* and *Parent* fields on the form being the only fields that require updating when moving a component from one aircraft frame to another.

### *Ease of use of system, Management of Site Based Rules & Alarms and Enhanced reporting and communication*

Dingo FleetOil™ was proven to be easy to use, capable of managing site based alarms and had the capacity to enhance reporting and communication through software demonstration and trial prior to purchase.

**Form: Equipment**

Eq #: A15-ATXMN-A9537  
 Description: Aft Transmission  
 SerialNum: A9537  
 In Service:   
 In Service Note:

**Equipment Information**

Make: Boeing  
 Model:  
 Person Resp: Bruce Tindall  
 Location: Townsville  
 Parent: A15102  
 EqType:  
 PrincipleEq: A15102  
 User:

**FleetOil Information**

Default InfoSource: DDF  
 Calculation Method:  Meter  Date  
 AlarmGroupID: A15-TXMN  
 EqGroupID:  
 Meter Location: A15-ATXMN-A9537

Equipment Fluids Parent/Child

v1.1

Figure 6: Dingo FleetOil™ Equipment Details Form

## Organisation Benefits

The primary benefit to the Royal Australian Army and Navy has been an improvement in the management of risk through the implementation of new processes and applications.

Other organisation benefits include

- freeing up of personnel time through more easily (a) identifying and managing components in exception and (b) managing component movement,
- eliminating duplicate systems,
- much improved confidence in alarm generation processes,
- much improved confidence in data integrity

The key lubrication condition monitoring staff member at the Royal Australian Navy, Dave Beattie, stated that he previously wasted a lot of time processing oil sample test-results into the old software application. He has said that since the introduction of Dingo FleetOil™ the time taken to process samples and generate exceptions from established alarms has reduced significantly. As a result, he has much more time to devote to productive analysis of component condition.

The Royal Australian Army has realised the benefit of not having to post updates of its condition monitoring software whenever new oil sample results are processed and component condition assessed. The old Excel application would have a master copy on the local network in Oakey with an updated copy posted to a Wide Area Network accessible drive for access by other interested personnel on update. Dingo FleetOil™ is viewable by anyone on the WAN and is always up to date.

Condition alarms are generated in FleetOil™ and do not rely on lab or personnel to “find” the concerning samples – all exceptions are brought to the attention of the user (regardless of lab comment) who then only spends time looking at exceptions and not looking through the OK results. The organisations benefit through the saving of personnel time, which allows them to focus on the more important condition analysis work function. Figure 6 shows the Dingo FleetOil™ Analysis form in which newly generated alarm exceptions can be reviewed.

Type	Level/TypeID	Equipment number	Sample date	Number	Description	Sample time
<input checked="" type="checkbox"/>	SPIKE	1302	21/02/1996	42	KATO KR-300 CRANE	9:00:00 AM
<input type="checkbox"/>	ACCELERATING	1504	16/01/1996	25	DEHAVILAND DHC 8-100 DASH 8	9:00:00 AM
<input type="checkbox"/>	ACCELERATING	2902	20/12/1995	29	CAT 988 CABLE REELER	9:00:00 AM
<input type="checkbox"/>	INCREASING	307	13/11/1995	31	BE 295B1 DRAGLINE	9:00:00 AM
<input type="checkbox"/>	EXTREME	307	30/05/1995	1	BE 295B1 DRAGLINE	9:00:00 AM
<input checked="" type="checkbox"/>	EXTREME	307	6/02/1995	1	BE 295B1 DRAGLINE	9:00:00 AM
<input checked="" type="checkbox"/>	EXTREME	525	21/02/1996	4	BULK LOADING CONVEYER	9:00:00 AM
<input checked="" type="checkbox"/>	EXTREME	525	24/09/1993	12	BULK LOADING CONVEYER	9:00:00 AM
<input type="checkbox"/>	SPIKE	602	4/01/1996	2	EUCLID R50 REAR DUMP	9:00:00 AM
<input type="checkbox"/>	SPIKE	602	22/03/1995	37	EUCLID R50 REAR DUMP	9:00:00 AM
<input type="checkbox"/>	INCREASING	602	11/01/1996	2	EUCLID R50 REAR DUMP	9:00:00 AM
<input type="checkbox"/>	SPIKE	604	21/02/1996	5	EUCLID R50 REAR DUMP	9:00:00 AM
<input type="checkbox"/>	SPIKE	604	13/12/1995	35	EUCLID R50 REAR DUMP	9:00:00 AM
<input type="checkbox"/>	SPIKE	901	19/10/1995	32	CLARK 380B LOADER	9:00:00 AM
<input checked="" type="checkbox"/>	MOD	904	28/11/1995	4	CAT 988B CABLE REELER	9:00:00 AM

Exception Overview / Exception Details  
15 records. 1 items selected.

Figure 6: Dingo FleetOil™ Analysis form

The Royal Australian Navy’s previous system was very specific, not intuitive and took time to learn. As a result, holiday coverage took planning and training. A single unplanned day off often-left samples unprocessed, which increased the risk of a component failure not being identified and acted upon. The new FleetOil™ system is more intuitive, and any computer literate fill-in person can easily learn the key processing actions. The resulting benefit to the organisation is that exceptions are still caught and can be actioned during the absence of key users.

## Summary

The Royal Australian Army and Navy had issues of ease of use, data integrity and single point of failure in the processes and applications they were utilising to monitor lubricated components. These issues increased the risk of component failure through lack of detection or slowness in component condition assessment. A solution was sought that addressed the core issues while retaining the capabilities the organisations already possessed. Implementation of Dingo’s MaintenanceGuy™ and FleetOil™ software addressed the issues.