WHAT IS RELIABILITY ENGINEERING?

Etienne Human
Carab Tekniva Group, Sasolburg, South Africa

1. INTRODUCTION

Engineering studies comply out of technical, advance technical and scientific studies where mathematics also plays a big role. At the end you'll have a Technician, Technologist or Engineer, specialized in different disciplines like Mechanical, Electrical, Electronical, Chemical or Industrial Engineering. They will apply their specialized knowledge in their different specialized fields.

The question to ask is: What is a Reliability Engineer? To contribute to the question: What is Reliability Engineering?

2. HISTORY OF RELIABILITY ENGINEERING

Reliability improvement is a natural consequence of failure analysis. Through the years it was a central feature of development. The principle of test and correct had been practiced long before there was procedures for data collection. Failures were self-evidence and lead to design modifications.

In many cases high levels of reliability was a result of over design. That was mostly the case in the nineteenth and early twentieth century. At that stage there was no need identified for quantified reliability assessment techniques. Failure data was not important.

The electronic age, accelerated by the Second World War, leads to more formal methods of reliability engineering. It gave a rise to the collection of failure information.

Today reliability engineering is a "discipline" on its own, and is also part of every engineering discipline.

3. RELIABILITY

Reliability is defined as the probability of a device performing its purpose adequately for a period of time intended under the operating conditions encountered.

The definition can be break down into four basic parts, namely:

- Probability
- Adequate Performance
- Time
- Operating conditions

Probability is the numerical input for the assessments to be conducted. Adequate performance is its "best" performance. There is always a time linked to it, for example a week or a month. The last thing is the operating conditions that are part of the performance of the system or equipment.

Reliability Engineering is the following, in order of priority:

- To apply engineering knowledge and with it specialized techniques to present or reduce the likelihood or frequency of failures.
- The identification and correction of the causes of failures that do occur, despite the efforts to prevent them.
- To determine ways of coping with failures, if their causes have not been corrected for some season or it is not possible to correct it.
- Apply method of estimating the likely reliability of new designs, and also for analyzing reliability data.

These four points describe Reliability Engineering. Figure 1 is an illustration of Reliability Engineering.

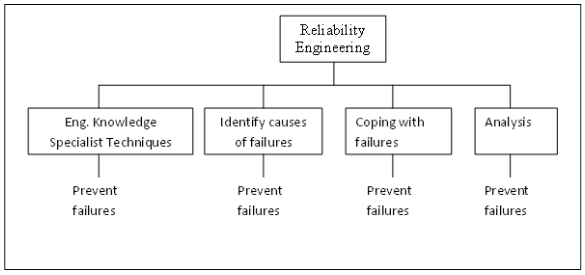

Figure 1 – The four functions of Reliability Engineering

4. FUNCTIONS OF RELIABILITY ENGINEERING

4.1 Apply Engineering knowledge with specialized techniques to prevent failures.

This is the function that makes the Reliability Engineer that special member of the team. He has basic knowledge of Instrumentation and Control Engineering, Electrical Engineering and Mechanical Engineering (the three main disciplines). With specialist/specialized techniques, the following is meant:

- The ability to develop and sustain a system to manage the Total Cost of Ownership of specific plant systems.
- The ability to develop and sustain a system to measure the integrity of plant systems. This includes the so-called "ility" measurements and Reliability Modeling.

- The ability to develop and sustain a system to measure physical conditions of plant equipment.
- A basic knowledge of the following CBM (Condition Based Maintenance) techniques:
  - Vibration analysis
  - Tribology
  - Thermography
  - Other (where necessary and required)

Tribology includes oil and grease analysis as well as surface analysis.
Thermography includes temperature related analysis and instrumentation.

- A basic knowledge of bearing analysis and how to apply it. Bearings are an important role player in equipment failure and for that reason it is important to have a thorough understanding of bearings and bearing failure patterns on mechanical and electrical equipment.
- The application of reliability tools like the Pareto Diagram or Sense Analysis or any other tools to determine potential failures or make failure predictions.
- Development of strategies to prevent failures, such like Maintenance Strategies.

4.2 Identify or correct the causes of failures

- Root Cause Investigations (RCI's) to determine the root cause of an incident. In this action the Reliability Engineer:
  - Play a leading role in the investigation
  - Must be able to do analysis by using tools like vibration data, bearing analysis, thermography, etc.
  - Collect all relevant data that is necessary to determine the root cause of an incident.
- Root Cause Analysis (RCA's) to analyze data that was collected in the RCI. In this action the Reliability Engineer:
  - Will facilitate the RCA session if he was not part of the RCI. It is necessary to have a facilitator with a neutral and clear mind to be objective and will not force his will down on the analysis.
  - Will not facilitate the RCA session if he was part of the RCI. In this case he will give his interpretation and analysis results to the RCA members to determine the cause of incident.

4.3 Determine ways of coping with failure if their causes have not or can not been corrected.

- Classical examples
  - Despite of the application of a certain CBM technique the failure rate is still increasing. The Reliability Engineer must be able to find a substitute for that technique. An example is:
    - Replace vibration analysis with temperature analysis and oil analysis.
  - Also to approve techniques of failure detection
    - Wall thickness testing is used to determine the condition of pipelines. Infra Red Scanning that is currently used on electrical equipment, is a better and more effective technique on pipelines.

Figure 2 is a classic way of coping with the problem. If you can't solve it, find a way to cope with it.

Some reasons for these situations:

- Sometimes it may be more economical to leave equipment in a faulty position until the opportunity occurs to change it.
- Repair or replacement may have been completed, but it may not be safe to restore the system to its operating condition immediately.

According to Fig. 1, this is to prevent failure, meaning any other failures.

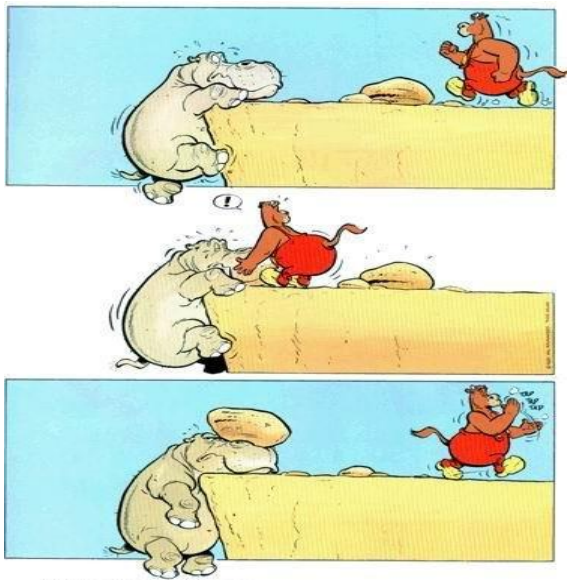

Figure 2 – Coping with a problem

4.4 The application of methods of estimating the likely reliability of new designs, and for analyzing reliability data.

- Reliability must also be in the design phase. There are two types of Reliability: Design Reliability and Achieved Reliability. Smith illustrates it as follows (Figure 3):

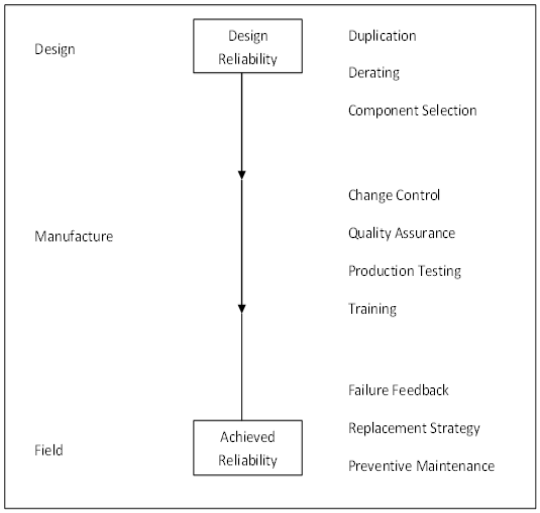

Figure 3 – Reliability

The Design Reliability is mostly the figure of a prediction exercise. Achieved Reliability is mostly an order (what must be achieved), and what is achieved (from failures).

The term RAMS are commonly used to describe:

R - Reliability
A - Availability
M - Maintainability
S - Safety

Through the engineering process, the system is designed and developed to ensure the ultimate product that is operationally feasible. This implies that the system will perform as it was intended to in an effective and efficient manner for as long as necessary.

5. CONCLUSION

Reliability Engineering is a multidisciplinary field of engineering. It involves techniques and procedures to analyze the performance of the equipment, and the reasons for failures and downtime.

Reliability Engineering tends to become a more and more important part of the engineering team and failure prediction as well as failure identification.

6. REFERENCES

[1] Billinton R, Allan RN, *Reliability Evaluation of Engineering Systems*, Pitman Advanced Publishing Program, 1985.

[2] Blanchard BS, Fabrycky WJ, *Systems Engineering and Analysis*, Prentice-Hall, 1998

[3] O'Conner PDT, *Practical Reliability Engineering*, John Wiley and Sons, 2004.

[4] Smith DJ, *Reliability Maintainability and Risk*, Butterworth Heinemann, 2003.

Author: Etienne Human is a Reliability Engineer and holds a master's degree in Mechanical Engineering from the University of Johannesburg. At present he is the senior asset management and reliability engineer at the Carab Tekniva Group. He is also registered as a senior member of the South African Institute of Electrical Engineers (SAIEE) and as a member of the South African Institution of Mechanical Engineering (SAIMechE).