1st International Symposium

Understanding Machine Failures

4 – 5 June 2007, Woodbury Park, Exeter, EX5 1JJ, United Kingdom

"I believe that the concept of failure is central to understanding engineering,….. . To understand what engineering is and what engineers do is to understand how failures can happen and how they can contribute more than successes to advance technology." **Professor Henry Petroski** , Duke University, USA

To Engineer is Human, The Role of Failure in Successful Design, Vintage Books, 1992, ISBN 0-679-73416-3

Discouraged **Corroded** **Incorrect assembly** **Head wind** **Incorrect tension**
Unbalanced **Vandalism** **Lost concentration** **Maintenance Error** **Rotted**
Rodent attack **Run out of fuel** **Melted** **Frost damage** **Incorrect wiring**
Smashed **Torn** **Stressed operator** **Shrunk** **Bird strike** **Air starved**
Battlefield damage **Collision** ***Defective Weld*** **Spalling** **Dented** **Fused**
Stretched **Transport damage** **Compression** **Bonding unsatisfactory**
Blistered **Discolored.** ***Fatigued*** **Pitting** **Misalignment**
Communication error **Burnt** **Distorted** **Incorrect storage** **Perished**
Solar radiation **Seized** **Twisted** **Faulty part** **Software error**
Drunk operator **Typing error** **Incorrect rating** **Poor electrical joint** **Bad weather**
Incorrect installation **Parts missing** **Faded** **Damp** **Blocked** **Spun off**
Eroded **Bogus part** **Creep** **Incorrect drawing** **Surface Discontinuities**
"Too fine sand" **Grooved** **Inadequate Design** **Temperature cycling** **Frayed**
Weld defective **Expanded** **Shark bite** **Flow-induced Vibration**
Bent **"Wrong snow"** **Oil saturated** **Punctured**

The MIRCE Akademy invites you to participate in this International Event. The objective of the Symposium is the further expansion of scientifically based knowledge for the understanding of machine in-service failure processes and causes. This knowledge could lead to the increase of machine in-service reliability and operational effectiveness, while reducing the risk of failures and their consequences to human, natural and business world.

The two-day event will host presentations, facilitate discussions and enable experience to be shared between experts from industry, government and research institutions, worldwide.

Announcement and Call for Papers for the future International Symposia related to Failure Understanding

	Date:	Deadline for Abstracts
2nd International Symposium	25-26 February 2008	29 October 2007
3rd International Symposium	16-18 February 2009	3 November 2008
4th International Symposium	22-24 February 2010	2 November 2009

G. Cole: "A significant number of failure mechanisms that occur in aero engines are characterised by a dichotomy in the modification standard of the components initially perceived to be "at-risk" to the problem. This dichotomy is often (but not always) driven by a quality issue, and is characterised by two "sub-families" of components. The first sub-family is "at-risk" to the attendant failure mechanism (i.e. bad), the second one is immune for some reason or the other and does not suffer from the problem (i.e. good). When such a situation occurs (if sufficient failure data is available) the Weibull plot for the problem will usually present quite a distinctive "dogleg" bend or "cusp". The challenge for the analyst is to establish the real engineering reason(s) for such a feature when present. Sometimes the answer will be found by examining the chronological history of the parts and looking for the telltale signs of a quality driven batch problem. Unfortunately, due to the rather complex nature of high technology, relatively low production volume, aero-engine components, a simple qualitative search for the "root cause" of the batch problem is not always successful. When dealing with this type of problem multivariate engineering measurement data on the "good" and "bad" components is sometimes available. The real challenge is to try to use this data to determine if any "pattern" exists that might provide a vital clue as to the root cause of the batch problem itself. This presentation will demonstrate how the MTS method can help in this type of situation. The presentation firstly outlines the basic MTS method as a pattern recognition tool. It then goes on to illustrate its application to a failure mechanism experienced on one particular standard of an aero-engine combustion chamber. Finally, basic conclusions are drawn on wider potential applications of MTS (and other more established Multivariate Statistical methods) in the field of Aerospace Engineering Quality and Reliability analysis."

B. Wharton: " Electronic products accumulate fatigue from the outset of their initial creation. This process begins with the soldering of components to a PCB and the machining or assembly of containing enclosure. For many products the pressures of time to market are assumed to preclude understanding the cost of ownership with respect to in-service failure. The primary environmental forcing factors are frequently those of temperature cycling and vibration that, because of their cyclic nature, cause fatigue damage accumulated throughout the product life cycle."

Day One – Monday 4 June 2007

08.15 09.00 - Registration	
09.00 09.05 - Opening Address	
09.05 10.00	Key note presentation * "*Using the Mahalanobis Taguchi System, MTS, to Further Analyse Failure Mechanisms which posses Weibull plots with dogleg bends*" Geoff Cole, Rolls Royce, Filton, UK.
10.00 10.45	*"Electronic product Fatigue and the Life Cycle Environment"*, Wharton Brian, 360Reliability Ltd, UK.
10.45 11.15 - Tea/Coffee	
11.15 12.00	*"Impact of the Strength Variability of Aluminum Alloys L113, L110, L164on Machine Failures",* Stuart Peake, Master Diploma Student, MIRCE Akademy
12.00 12.45	*"Failure Analysis of ABS Control Unit on Citroen C3 car"*, Ian Zaczyk, Master Diploma Student, MIRCE Akademy
12.45 13.45 - Lunch	
13.45 15.15	Case Study: ***"Apollo 13: Diary of Failures*** " Documentary film, NASA archive, 80 min
15.15 15.45 - Afternoon Tea	
15.45 17.30	"Formula 1 Failure Analysis 1950 – 2006" followed by a visit to the Nigel Mansell World of Racing
19.15 19.45 - Sherry Reception	
19.45 22.30 - Symposium Dinner	

S. Peake "The tensile strength of Aluminum Alloys Tested demonstrated probabilistic variability across all samples, which could be successfully modelled by the Weibull probability law."

I. Zaczyk: "This presentation considers the real life case history of a Citroen C3 ABS control unit failure. It investigates the system cause-effect relationships resulting from: Environmental World, Living World, Internal Processes, Human World. On the 3rd. March 2006 - intermittent failure occurred that illuminated the ABS, Brake and Engine Management warning lights on the instrument display. The loss of the speedometer reading and the failure of the cars power steering accompanied this. The rest followed …….. "

J. Lowell, Apollo 13 commander: "*I could see a gaseous substance escaping ……. That's was when it definitely occurred to me that we are in deep trouble. Very shortly, we'd be completely out of oxygen."* were his words as he heard ominous explosion that robbed the most of their oxygen, food and water, 200,000 miles from Earth.

Day Two – Tuesday 5 June 2007

08.15 09.00 - Registration	
09.00 09.05 - Opening Address	
09.05 10.00	Key note presentation *"A Catalogue of negative events leading to tragedy – How individually non-catastrophic mistakes can cause fatal accidents, when linked together"* Robert Foggon, NAMSA, (NATO Maintenance and Support Agency) Luxembourg
10.00 10.45	*"Human Impact on Machine Failures"*, Clive Nicholas, Mirce Engineering, UK
10.45 11.15 - Tea/Coffee	
11.15 12.00	*"Trial Bike: Failures, Understanding and Preventions*, Juha Sipila, Pasi Lehtola, Jyvaskyla University of Applied Science, Finland
12.00 12.45	"*Failure: Plan vs. Reality*" Tony Martin, Fellow MIRCE Akademy
12.45 13.45 - Lunch	
13.45 15.15	Master Class: *Physical Scale of Machine Failures*, from 10^{-10} m to 10^{0} m, J.Knezevic, MIRCE Akademy, Exeter, UK
15.15 15.45 - Afternoon Tea	
15.45 17.00	Master Class continues From 10^{0} m to 10^{+10} m

T. Martin: "Failures are the only obstacles to the realisation of plans, but they are also the only certainty in reality."

J. Knezevic: "In order to understand machine life it is necessary to understand its physical processes and human actions. Answers to the questions **"what is the real cause of failure** events like: fatigue, the wind direction change, "hangar error", faulty weld, bird strike, perished rubber, carburettor icing", to name just a few, have to be provided. Without an accurate answer to those questions the prediction of their future occurrences are not possible, and without ability to predict the future, the use of the word science becomes inappropriate. My research has shown that any serious studies in this direction, have to be based between the following two boundaries:

- the "bottom end" of the physical world, nothing bigger than the atom system, 10^{-10} m
- the "top end" of the physical world, nothing smaller than the solar system. 10^{10} m

This range is the minimum sufficient "physical scale" which enables the understanding of cause-effect relationships between operational life and failure events, and provides enough information for the accurate predictions to be made."

R. Foggon: "The paper will detail the mundane events that lead to the tragic accidental death of a soldier. A catalogue of events which on investigation highlighted poor maintenance, a contentious modification made years before, training, visibility, documentation, the time of day and the victim-to-be suffering from being wet – all played their part in the dreadful accident. The main objective of the paper is to show that the simplest mistakes can lead to disastrous consequences when investigations begun, all sorts of health and safety issues are brought to light. Tiredness, complacency and repetitiveness are the great work dangers."

C. Nicholas: "Most efforts in addressing human error has been placed upon the role of the system maintenance processes of the operator through personnel training, through the adoption of safe procedures and good practices. However, the research performed by the author has shown that there is a significant impact of the system design on potential human error in maintenance that has to be addressed. This paper examines how specific design strategies can be developed and can be used to reduce the occurrence of human error in system maintenance process and to mitigate its consequences on humans, business and environment."

Sipila & Lehtola: "The life of trial bike is full of failures, only those who understand them can do something about them, and only then the victory will come."

The Venue

The Symposium will be held at **Woodbury Park Hotel, Golf and Country Club**, which is approximately eight miles from Exeter by road.

Communication between Exeter and other parts of the United Kingdom are excellent.

By road, the M5 motorway links Exeter to London, the Midlands, Scotland and Wales. Regular rapid coaches run services to and from London and Heathrow Airport.

By rail, a regular fast service is available to and from Exeter (St David's Station) and London (Paddington Station).

By air, Exeter Airport offers regular flights to many British and Continental destinations and is situated near to Woodbury Park. Travel between Exeter and Woodbury normally requires a car or taxi.

Delegates are responsible for the arrangement and payment of their own travel and accommodation. Delegates wishing to take advantage of preferential room rates should contact Woodbury Park Hotel Reservations quoting 'MIRCE'.

Woodbury Park Hotel, Golf and Country Club,
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Registration Form

THIS FORM MAY BE PHOTOCOPIED

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Online www.mirceakademy.com **email: quest@mirceakademy.com**

SYMPOSIUM PRICES (in GB Pounds £)

Full Programme	Fee	VAT	Payable
• Participants	495.00	86.63	**581.63**
• MIRCE-Fellows	595.00	104.13	**699.13**
• MIRCE-Students	295.00	51.63	**346.63**
One Day Programme			
• Monday	295.00	51.63	**346.63**
• Tuesday	295.00	51.63	**346.63**
Other Rates			
Symposium Proceedings	150.00	26.25	**176.25**
Symposium Dinner	42.55	7.45	**50.00**

COST

The full Programme Package includes: Attendance to all Sessions, Supporting Materials, Lunches and Light Refreshments and Symposium Dinner

VALUE ADDED TAX (VAT)

Unless special exemption exists, under UK Customs and Excise regulations delegates from all countries are required to pay UK VAT @ 17.5% on all courses taking place in the UK. Non-UK delegates may be able to recover VAT incurred via the relevant tax authority in the country of origin of the delegate.

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Substitution of participants may be made at any time. If you intend to do this, please advise the MIRCE Science ('the organiser') as soon as possible. Cancellation of a booking must be received in writing by the organiser at least 14 days before the commencement of the Symposium. MIRCE Science regrets that no refunds or credits will be made after the deadline unless the organiser cancels the Symposium.

The organiser reserves the right to alter the programme or cancel the Symposium at its discretion. All places offered are subject to availability.