

# Mirce Mechanics Foundation School

on

## Time Between Failures – TBF

Scientific method for the accurate predictions of Time Between Failures

The MIRCE Akademy, Woodbury Park, Exeter, UK

Since its beginning, in 1950s, Reliability Engineering has been based on mathematical theorems rather than on scientific theories. Massive attempts were made to further the applications of the existing mathematical and statistical methods and analysis without any attempt to understand failure phenomena and their mechanisms.

In the 1980s, practicing reliability engineers and analysts, used their practical experience of the observed failure modes of existing systems. Thus, a large number of “practical reliability methods” have been developed and used, all of which were based on the failure mode, effects and criticality analysis (FMECA), but still without understanding and addressing failure mechanics.

Consequently, during the last 50 years Reliability Theory has made very little progress, apart from a few exceptions, in the direction of becoming a “science”, in terms of making accurate predictions that could be confirmed with in-service observations. The reason is very simple; neither statistics, which does not study causes of statistical behaviour, nor engineers whose “applied methods” were focused on meeting contractual and legal requirements, were able to provide a fertile ground for the understanding of MTBF.

Topics to be covered, explained, clarified and illustrated with numerical examples and case studies

- The physical meaning of .....
- The mathematical meaning of .....
- The engineering meaning of .....
- The management meaning of .....
- The customers understanding of .....
- The accuracy of cost predictions based on .....
- The accuracy of spares predictions based on .....
- The accuracy of maintenance frequencies based on .....
- The accuracy of facilities planning based on .....
- The accuracy of cost predictions based on .....

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All of the above and other MTBF driven issues will be addressed in respect to:

- Component
- Module
- Subsystem
- System
- Platform
- Fleet

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**Recommendation:** The School is suitable for all of those who would like to know the correct answers to the above, and similar, questions, as the competitive advantages of their companies and their professional career will depend on them.

**Warning:** It is not suitable for those who wish to learn how to apply existing standards and current administrative practices required for the satisfaction of contractual reliability paperwork.

## **Mirce Mechanics - science that predicts the future**

At the MIRCE Academy we have observed and analysed the motion of a large number of failure phenomena, negative and positive, through the operation, maintenance and support processes. We have understood the mechanisms, the frequencies, and the dynamics of the motion of those phenomena in the life of large number of industrial systems in order to determine and formulate their relationships. Finally, their physical relationships have been captured and described through mathematical formulas that enable accurate predictions of their future trajectories to be made. This has given birth to the ***Mirce Mechanics, the science of the motion of failure phenomena through the life of in-service systems, resulting from physical causes and human actions.***

The main objective of this Mirce Mechanics Foundation School is to present the:

- Concept,
- Main principles
- Methods

of the Mirce Mechanics that are directly related to the predictions of the Mean Time Between Failure, MTBF, which is the driving force behind all reliability, maintainability, supportability, availability, life cycle cost, operational availability and similar predictions, compulsory required to be performed during defence, aerospace and other safety and reliability driven industries.

## **Programme for Day 1:**

### **9.00- 13.00: System Failure Mechanisms**

System failures are events that cause transition of a system from functional to failed state due to some of the following reasons, or combinations of them:

- Built-in design errors (incorrect selection of materials, stresses shapes,
- Production problems (human errors, material and process deficiencies)
- Irreversible changes in the condition of components with time due to wear, fatigue, creep, corrosion, and similar degradation processes
- Imposition of external overstress mechanisms resulting from collisions, harsh landings, extreme weather conditions, etc
- Human errors in execution of maintenance tasks
- Human errors in execution of in-service support tasks

A large number of failure events and associated phenomena that have been observed and analysed to understand the physical mechanisms that generate occurrences of failures will be discussed in this part of the course, mainly rotated to defence, aerospace and auto racing industries.

### **14.00 – 17.15 System Failure Statistics (The objective is to learn the pattern in the data)**

- **Numerical Summary of Data**
  - Average Value
  - Middle point
  - Range of the Data
  - Variability of the Data
- **Graphical Representation of Data**
  - Histograms of the Frequency of the failure occurrences
  - Histogram of Failure Function

## **Programme for Day 2:**

### **9.00- 13.00: Physical Categorisation of Failure Mechanisms**

- Inherent failure causes (design error, manufacturing and production problems, maintenance induced failures, shelves life, packaging, handling, transportation problems, etc.)
- Accidental failure causes (foreign object damage, environmental causes like hail, snow or sand storms, battlefield damage, operator's errors, etc.)
- Cumulative failure causes (ageing, corrosion, fatigue, wear, creep, etc.)

### **13.00 - 17.15 Analytical Description and determination of Failure Mechanisms.**

- Concept of Failure Function for a single Failure Cause
- Life factor and Failure factor for:
  - Failure Function for Inherent failure causes
  - Failure Function Accidental failure causes
  - Failure Function Cumulative failure causes
- Concept of Failure Function for a multiple Failure Causes
- Concept of Expected Time To Failure for:
  - A single failure cause
  - A multiple failure causes

## **Programme for Day 3:**

### **9.00 – 13.00: Mean Time Between Failures for Non-repairable Systems**

- Predictions
- Impact on Inspections and retirement
- Impact on the In-service Cost Predictions

### **14.00 - 17.15 Mean Time Between Failures for Repairable Systems**

- Predictions
- Impact on Inspections and retirement
- Impact on Schedule maintenance (candidates, frequencies and groups)
- Impact on the Support Infrastructure
  - Spares
  - Personnel
  - Facilities
  - Equipment and Tools
- Impact on the In-service Cost Predictions

### **Additional Information:**

No previous knowledge of probabilistic and statistical mathematics is required. The course is designed for the technically minded project managers and engineers who do need to understand the physical meaning mathematically determined value for MTBF by people who neither understood mathematics nor physics of failure mechanisms. This is imperative, if the future projects are to be better understood and delivered on time and price. Although not all, but one of the main drivers for project overruns is lack of understanding of the physical meanings of MTBF numerical values.



**Dr Jezdimir Knezevic** is a world class researcher, educator and entrepreneur. Over 350 publications disseminated world-wide through books, papers, monographs and reports are attributed to his name. In addition, he has delivered numerous technical presentations, key note addresses and speeches; has been congress, conference, symposium chairman, track leader, workshop presenter, round table moderator on many hundreds international events which took part in all six continents in over 40 countries. He has been elected as a Fellow, Member or Official of many leading Professional Societies and Institutions worldwide, and has been actively involved in editorial work with the world's leading and prestigious referred journals and publishing houses

In 1999 Dr Knezevic formulated the concept of Mirce Mechanics, the scientific study of the motion of functionality (ability-to-function) through the life of maintainable systems, resulting from physical causes and human actions. To fully focus on the further development, dissemination and application of Mirce Mechanics, he left Exeter University to establish the MIRCE Akademy, at the Woodbury Park, Exeter, UK. Under his leadership, the Akademy has educated thousands of professionals coming from Industry, Government and Military Organisations world-wide, some of them have received internationally recognised Master or Doctoral Diplomas.

Dr Knezevic regularly provides services to private and public sector organisations regarding their needs for managing in-service reliability, cost and effectiveness, for a given system structure, operational conditions and policies, based on scientific understanding of the causes and mechanisms of positive and negative failure phenomena.

He shares life with Lynn, is passionate about motorsport, is challenged by rusty, but beautiful Lancia cars, and enjoys a thatched house in tranquil Devon, England.



The International School will be held at **Woodbury Park Hotel, Golf and Country Club**, 8 miles from Exeter.

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 or Waterloo Station - connection to Euro Star).

**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, Woodbury, Exeter, EX5 1JJ, United Kingdom

**Tel +44 (0) 1395 233 382**

Email [enquiries@woodburypark.co.uk](mailto:enquiries@woodburypark.co.uk)

Web [www.woodburypark.co.uk](http://www.woodburypark.co.uk)

A list of alternative accommodation in other hotels and guesthouses in the vicinity is available on request.

# Mirce Mechanics Foundation School

## Registration Form

THIS FORM MAY BE PHOTOCOPIED

Phone +44 (0) 1395 233 856

Mail MIRCE Akademy, Woodbury Park, Woodbury, Exeter, EX5 1JJ, United Kingdom

Email: [quest@mirceakademy.com](mailto:quest@mirceakademy.com)

Web site: [www.mirceakademy.com](http://www.mirceakademy.com)

International School Prices (in GB Pounds £)	Fee	VAT	Payable
• Participants	950.00	190.00	<b>1140.00</b>
• Fellows of MAk	900.00	180.00	<b>1080.00</b>
• Members of MAk	850.00	170.00	<b>1020.00</b>
• Students of MAk	750.00	150.00	<b>900.00</b>

### The Price includes:

- Tuition
- Supporting Materials
- Lunches
- Light Refreshments

### Value Added Tax (VAT)

Unless special exemption exists, under UK Customs and Excise regulations delegates from all countries are required to pay UK VAT @ 20 % 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.

### PAYMENT DETAILS

Please invoice my organisation  
(Note: UK MOD personnel can pay by BACS through the DBA – Contractor Number will be supplied with invoice)

For the attention of \_\_\_\_\_

Purchase Order No. \_\_\_\_\_

Please find enclosed a cheque for £ \_\_\_\_\_  
(Made payable to MIRCE Akademy)

Please charge credit card

Visa                      MasterCard                      Amex

Cardholder \_\_\_\_\_

Card No. \_\_\_\_\_

Expiry Date \_\_\_\_\_

Signature \_\_\_\_\_

### PERSONAL DETAILS (Please print clearly)

Surname \_\_\_\_\_

First name \_\_\_\_\_

Organisation \_\_\_\_\_

Department \_\_\_\_\_

Position \_\_\_\_\_

Address \_\_\_\_\_

Postcode \_\_\_\_\_ Country \_\_\_\_\_

Tel \_\_\_\_\_

Email \_\_\_\_\_

Special requirements                      Yes                      No

Please specify

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I understand and accept the registration terms and conditions as shown

Signature \_\_\_\_\_ Date \_\_\_\_\_

### Terms and Conditions

Substitution of participants may be made at any time. If you intend to do this, please advise the MIRCE Akademy ('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 International School. MIRCE Akademy regrets that no refunds or credits will be made after the deadline unless the organiser cancels the Event.

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