Achieving Reliability from Data

You Can Build and Implement Optimal Decision Policies with Living RCM Certified

For many decades now, maintenance engineers have tried to harvest data so as to improve the reliability and lower the cost of operating the physical assets within their operations. They gathered, manipulated, displayed, and stored data in great quantities. Today, limitless data emanates from the Enterprise Asset Management (EAM) system as well as from Condition Monitoring programs such as vibration monitoring, oil analysis, and motor current analysis Equipment embedded sensors can communicate through the Industrial Internet of Things (IIOT). Operational and control data stream into real time databases adding further possibilities and complexity to the goal of *achieving reliability from fact*. A robust cost/benefit return on invested resources devoted to data centric maintenance activities must, nevertheless, bear the scrutiny of the chief financial officer. This course addresses that specific challenge.

The “Achieving Reliability from Data” course (both live and eLearning format) is comprehensive and based on the Living RCM Certified process. It provides the maintenance manager or engineer with confidence in his knowledge of every reliability related topic *relevant* to the practical maintenance environment. The course has four modules. Participants will, upon completion, know precisely the practical actions they and their colleagues must take in order to transform their data to cost effective reliability.

Who Should Attend

The “Achieving Reliability from Data” course will provide vital guidance to maintenance, operational, management, and engineering personnel, all of whom will benefit from the skills required to model maintenance related data for the purpose of optimal, verifiable, day-to-day decision making.

- Engineering Managers
- Facility Managers
- Instrumentation Engineers and Key Process & Instrumentation Technicians
- Maintenance Engineers
- Maintenance Foremen
- Maintenance Managers
- Maintenance Planners
- Maintenance Superintendents
- Maintenance Supervisors
- Operations Managers
- Physical Asset Managers
- Plant Directors
- Plant Engineers
- PM/PdM Coordinators
- Property Managers
- Reliability Managers
- Reliability Engineers

From Industries including but not limited to:

Mining, Oil & Gas, Utilities, Petrochemicals, Pharmaceutical & Healthcare, Government, Construction, Food & Beverages, Manufacturing, Automotive, Chemicals etc. And ALL other industries that see physical asset management as a factor to business success, such as facilities management and healthcare facilities management operations.

12 Key Benefits of Attending this TrueWorkShop™

1. ***DEFINE*** the most fundamental problem in maintenance management.
2. ***OVERCOME*** the uncertainty inherent to the maintenance decision process.
3. ***USE*** reliability analysis software and tools for practical decision making
4. ***INTEGRATE*** EAM historical data with business data and condition data in a model based optimal CBM decision process
5. ***DETERMNE*** precisely what data is relevant to maintenance decision making with statistical methodes.
6. ***UNDERSTAND*** and avoid the pitfalls of excessive detail in RCM and subsequent work order reporting.
7. ***LEARN*** the comprehensive language of RCM so that each maintenance situation can be conveyed and documented.
8. ***APPLY*** Reliability-Centered Maintenance (RCM) thinking to day-to-day work order related tasks for continuous documentation of knowledge in a dynamic maintenance environment
9. ***IMPROVE*** your Preventive (PM) & Predictive Maintenance (PdM) Programs through the natural work order process.
10. ***OBTAIN*** management buy-in for your proposed improvement programs based on solid data grounded evidence.
11. ***DEVELOP*** a practical evidence supported program driven by model based CBM decision policies
12. ***MEASURE*** and ***CONTINUOUSLY*** improve your CBM program with robust statistical/financial tools.

Pre Course Work

We encourage participants to peruse the course material, eLearning moduels, powerpoint slides, a full set of notes This will stimulate discussion. The goal of “Achieving Reliability from Data” in your organization, should be kept in mind at all times.

Important Post Course Work

Following the **TrueWorkShop™**, delegates may apply the skills they acquired during the course to their own work making use of the cloud deployed software tools practised in the course.

Day One

Maintenance decisions – basic problem statement

- When to maintain? The basic problem.
- The basic problem
- Reliability attributes
- Can the probability distribution be known exactly?
- Wide versus narrow distribution
- Adding a dimension to the analysis
- Narrowing the solution

Formal definition of CBM: *Decision factors: probability of failure and severity of consequences*

Initial RCM

- Reliability
- Expanding expectations of Maintenance
- Need for RCM
  - ✓ Expanding expectations of Maintenance
  - ✓ New understanding of asset failure behavior:
  - ✓ New maintenance technology
- Structured approaoch to maintenance
  - ✓ Desired performance
  - ✓ The 7 question backbone of RCM
  - ✓ Operating context

Functional analysis – RCM Question 1

- The f;unction statement
  - ✓ Syntax
  - ✓ Primary and secondary functions
- Performance standards
  - ✓ Multiple
  - ✓ Quantitative
  - ✓ Qualitative
  - ✓ Absolute
  - ✓ Variable demand
  - ✓ Upper and lower limits
- Steps in the functional analysis process

Case studies*: (Aircraft) Air-conditioning pack, Distributed control system (DCS), Rail car suspension exercise.*

Day Two: Failure Modes & Effects Analysis (FMEA), Consequences of failure, Failure management policies, Living RCM Certified

Functional failure – RCM Question 2

- Total versus partial failure
- Competing organizational standards

Failure mode – RCM Question 3

- Failure mode syntax
- Depth and detail
- The "due to" clause
- Human error

Failure effects – RCM Question 4

- Repair action
- The effects narrative
- Zero-base analysis

Failure consequences – RCM Question 5

- Hidden consequences and tolerable risk
- Health, Safety, and Environtmental (HSE) consequences
- The economics of operational and non-operational consequences
- Criticality analysis

Failure management policies – RCM Question 6

- Condition based maintenance (CBM)
- Age or time based maintenance (TBM)
- Failure detection
- Redesign
- No scheduled maintenance (NSM)

Living RCM Certified

- Optimal maintenance decision models
  - ✓ Optimizing objectives
  - ✓ Data for optimization and the work order
- Theory and practice
- The nature of data
- What is a sample

Getting Started – Living RCM Certified

- Failure mode instance selection
- RCM knowledge feedback and management
- RCM knowledge history trail
- Empowerment and recognition
  - ✓ Leading and lagging KPIs
  - ✓ The RCM knowledge dashboard
- CBM Operations Phase

Living RCM group exercise

Day Three: Reliability analysis, CBM Optimization modeling, RAM analysis, Root cause analysis,

Reliability analysis in 2 dimensions

- Conditional probability of failure and Failure ratet
- Mean time to failure
- Reliability analysis is counting
- Real meaning of the 6 RCM curves
- How to draw the curves
- Maintenance decision optimization
  - ✓ Useful life
  - ✓ What do we mean by "optimal"
  - ✓ The cost model
  - ✓ Conditional failure probability
  - ✓ Random failure
- Workshop – Weibull analysis and PM optimization
  - ✓ Analysis of Engine, Clutch, Starter motor failure and suspended data
  - ✓ Age preventive maintenance policy
  - ✓ Spares requirement calculation
  - ✓ Interval and deterministic policies

Reliability analysis in > 2 dimensions

- Classic CBM P-F Model
  - ✓ Estimating the P-F and monitoring intervals
  - ✓ Weaknesses of the P-F model
- An alternative to the P-F model for CBM
- Predictive maintenance effectiveness
- Building and deploying an optimal CBM model

RAM analysis

- Purpose and types of performance prediction
- RAM technique – Monte Carlo Simulation (MCS)
- Workshop – Group exercises

Root Cause analysis

- Undesired outcomes, Events, Conditions, and Barriers
- Proximate causes, Root causes, Intermediate causes, Contirbuting factors.
- Cause and effect diagram
- Accident investigation – sequence diagrams
- RCA tools

Even in Good Economic Times Maintenance is Forever!

TrueWorkShop™ Topics

We also provide many *very* important deliverables in an easy to use Excel format in addition to the program outlined below.

1. **The Scoreboard for Maintenance Excellence** - Today's most comprehensive benchmarking tool for each attendee's operation that benchmarks your site against today's best practices.

2. **The CMMS Benchmarking System** - For gaining maximum value from an existing CMMS

3. **The Reliability & Maintenance Excellence Index** - A powerful measurement process to validate shop level results.
4. Electronic copies of TMEII two major books; **Maintenance Benchmarking and Best Practices (McGraw-Hill-2006) and Reliable Maintenance Planning, Estimating and Scheduling (Elsevier-2015)**

Take An Important First Step:

This training process is for application and not theory and is for both the public and private sector in plant maintenance and pure facilities maintenance. Remember, we guarantee this **TrueWorkShop™** will help provide you with the important steps to improve the maintenance process and the business side of the maintenance in your operation.

If results from this TrueWorkShop™ do not provide at least a 10-to-1 Return-on-Investment, to cover your time and training costs, you will receive a complete refund.

Ralph W. Peters
Founder-President-Coach for TMEII

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What is a TrueWorkShop™?

The Maintenance Excellence Institute International believes the principles and practices covered can be taken back and put into practice for a true return on investment for the training we provide:

- ✓ Pre course work:-self assessment of attendee's operation
- ✓ Extensive knowledge base for each topic
- ✓ Extensive practical exercises on key topics
- ✓ Extensive idea sharing and instructor's case studies from over 300 plant and facility sites.
- ✓ Plan of action for attendee's Top 5 Areas for Improvement
- ✓ Personal TMEII follow up *after* each session

It's a 'How To' Step-by-Step Approach

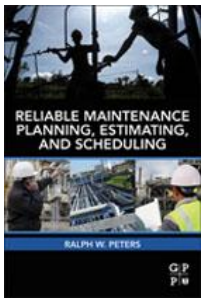
This **TrueWorkShop™** will guide you step-by-step through the PM & PdM installation process, helping you to:

- Progress forward to ISO55000
- Learn how to develop an initial maintenance plan with RCM
- Define criticality of assets, your repair problems, and goals
- Develop the optimum PM & PdM plus CBM program for your operation
- Understand RBM for the optimum safety
- Justify your investment and validate the benefits
- Develop a realistic Plan of Action
- Measure total operations benefits with your Reliable Maintenance Excellence Index
- Sell your program to Top Leaders and continue it long- term.

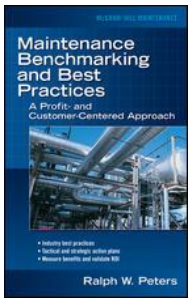
After this **TrueWorkShop™** you will know how to reevaluate your maintenance situation periodically with **The Scoreboard for Maintenance Excellence™**, how to improve top priority areas, and how to get the results you want.

Extensive References to Take Home:

This workshop is based on Pete's two books:



Reliable Maintenance Planning, Estimating and Scheduling



Maintenance Benchmarking and Best Practices

TMEII provides more electronic references than any other course now being offered in the world.

Each organization will receive e-book copies of these books plus many, many more valuable references on CD. The electronic versions are included to allow easy application and duplication of all materials in this book.

All PowerPoint's in the used in course are included and "The Mother of All Maintenance and MRO Materials Management Glossary" are included.

We Personally Guarantee This TrueWorkShop™!

We will give you the firepower and knowledge needed to implement a successful PM program and to use the Predictive Maintenance technologies that apply to your operation. We will reinforce your current maintenance needs to the top leaders in your organization. We will help you be "the maintenance messenger" to get action from Top Leaders.

We can personally help you make a difference in the total operations success of your organization after you attend this

event! Top Leaders must clearly understand your needs and the consequences of gambling with maintenance costs and a bad PM and PdM program.

Why You Should Attend this TrueWorkShop

With each new generation of data acquisition tools proliferate it is tempting to focus on the technology and defer indefinitely critical analysis of the data itself. If you are an engineer or manager in maintenance, you can be quickly overwhelmed by limitless data. You should thorougly understand the universal nature of data related to physical asset management. You will learn how to discriminate *relevant* data from data that does not bear upon practical decision making for cost effective reliability. You will learn how to develop and test data centric optimized policies condition based maintenance.

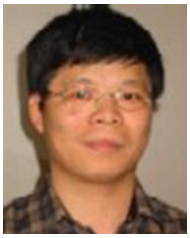
Your Instructors and Coaching Team

Ralph W. (Pete) Peters the Founder/President of The Maintenance Excellence Institute International is your primary instructor. His experience of over 40 years has included being a manufacturing plant manager at two sites; director of facilities management. He has had extensive maintenance experience within the US Army beginning in Vietnam (1970) and with the US Army Corps of Engineers building what is now called, the National Highway.

He consults and provides maintenance best practice training in over 30 countries, written maintenance chapters in four books as well as a book on *Maximizing the Value of Your CMMS*. In 2006, he wrote and published *Maintenance Benchmarking & Best* Practices for McGraw-Hill's professional book division. In 2015 he completed Reliable Maintenance Planning, Estimating and Scheduling for Elsevier's Gulf Publishing Division.

Pete's positive approach and his experience from consulting, allows him to be an excellent coach for today's top leaders, maintenance leaders and craft leaders. His worldwide ***PRIDE-in-Maintenance*** initiative will be highlighted in his next book with key topics from this universal book included in all of his worldwide **TrueWorkShops™**.

Murray Wiseman innovates in maintenance engineering, management, and consulting, with particular focus on using maintenance and operational data to achieve reliability. He founded and operated the world's first web expert system- based commercial oil analysis laboratory. As a principal consultant at PricewaterhouseCoopers' Centre of Excellence in Physical Asset Management he specialized in condition-based maintenance optimization. He is a RCM practitioner. He leads projects in condition-based maintenance optimization that achieve cost effective, safe increased equipment availability. He developed in collaboration with Carbones de Cerrejon the groundbreaking Living RCM Certified process designed to achieve reliability from data. He is President of LivingReliability Inc., a software and consulting company dedicated to strategic reliability information and knowledge management. Murray holds a B. Eng. Mech. degree from McGill University. Murray's articles and videos can be seen at www.livingreliability.com/en.



Daming Lin is Chief Statistician and Technology Director of OMDEC / LivingReliabiltiy Inc. As a researcher in statistical maintenance modeling at the University of Toronto's (Centre for Maintenance Optimization and Reliability Engineering (C-MORE) he contributed to the theory and development of EXAKT and the Living RCM Certified process. He has conducted numerous projects in CBM decision modeling and in reliability. Daming developed practical solutions to the unifying of the EAM and RCM in order that rigorous Reliability Analysis may be applied. He has conducted Life cycle costing analysis for underground gas pipe lines and optimizedf preventive maintenance intervals in underground mine equipment. He is the developer of OREST reliability software. He received a Ph.D., 1995, in Statistics, from the University of Hong Kong, Hong Kong, China and an M.Sc., 1988, Applied Mathematics, Ins. of Systems Science, Chinese Academy of Sciences, China and his B.Sc., in 1985, in Applied Mathematics, Peking University, China. He was a University of Toronto, Postdoctoral Fellow. He is the author of over 20 papers in international journals & 20 papers in international conferences. Daming is fluent in Mandarin and Cantonese.

Training is Not Over When it's Over!

Your company will benefit most if you attend as part of a 3 - 4 person company team which will work together. You return to your organization with the new knowledge and team support for PM and PdM along with your new plans for reliability and maintenance excellence. We invite your

Top Leaders, Maintenance Leaders and Craft Leaders to attend as a team. The workshop **"is definitely not over when it's over." Yogi Berra once said, "It ain't over until it's over!"**

Your session is definitely not over when it's over! Following completion of this **TrueWorkShop™** a personalized follow-up will be scheduled for each attending participant and organization. Our one-on-coaching is to help you apply the key topics and to implement your plan of action. Implementation is your key to results and we want to help you make that happen!

TRAINING INVESTMENT:

Your Investment of $1,395 per person for a 3-Day Session is the World's Best Educational Value!! In Fact, register 3 and the 4th person attends for FREE! That is a 25% savings for a Team of 4.

PRIDE Members – You will receive an additional 10% discount on your entire purchase.

Investment:

Training is an investment and *all* of TMEII's **TrueWorkShops™** are today's best value. They are results-oriented and focus on implementation.

For a 3-day session your investment is $1,395 per person, but pay for 3 and send a 4th person **FREE.** That is an immediate and a direct savings of 25%.

TrueWorkShop™ schedule is from 8:30 AM to 3:30 PM each day. All lunches and reference materials are included. Dress is casual.

a) **Provide a purchase order number and attendees names:** We will send an electronic invoice to your organization

b) **Send checks payable to: The Maintenance Excellence Institute International**
6809 Foxfire Place, Suite 100 ♦ Raleigh, NC 27615

c) **Register Now & Pay Online:** We accept Visa, MasterCard and American Express

d) **Direct Bank Deposit**: Contact us for direct wire transfer information of your payment*

In-House Opportunities With No Boundaries!

We Can Help You Plan This Program at Your Site as a Customized In-House Event No Matter Where You are Located.

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E-Mail: Pete@PRIDE-in-Maintenance.com