

Plant and Equipment Wellness

Plant and Equipment Wellness

*A Process for Exceptional Equipment
Reliability and Maximum Life Cycle Profits*

Mike Sondalini



EA BOOKS

© Mike Sondalini 2009

All rights reserved. Without limiting the rights under copyright above, no part of this publication shall be reproduced, stored in or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise) without prior permission of both the copyright owner and the publisher of this book.

National Library of Australia Cataloguing-in-Publication entry

Sondalini, Mike.

Plant and equipment wellness : a process for exceptional equipment reliability and maximum lifecycle profits / Mike Sondalini.

ISBN: 9780858255289 (pbk.)

Includes index.
Bibliography.

Plant maintenance – Management.
Machinery – Maintenance and repair.

658.202

Published by Engineers Media and distributed by EA Books, 2 Ernest Place, Crows Nest, NSW 2065, phone 02 9438 5355, fax 02 8823 6526, www.eabooks.com.au, from whom further copies may be obtained.

Printed by Ligare Pty Ltd, 138 Bonds Road, Riverwood NSW 2210

Contents

Preface.....	vii
Introduction	ix
PROCESS 1 – Operating Risk Identification	1
<i>Description of Process 1 – Risk Identification</i>	<i>2</i>
1. Reliability of Processes	3
2. The Physics of Failure.....	16
3. Variability in Outcomes.....	24
4. The Instantaneous Cost of Failure	44
5. Preventing Life Cycle Risks	61
PROCESS 2 – Operating Risk Rating	73
<i>Description of Process 2 – Risk Rating</i>	<i>74</i>
6. Pathway to Plant and Equipment Wellness.....	75
7. Defect Elimination and Failure Prevention	86
8. Operating Equipment Risk Assessment.....	107
PROCESS 3 – Select Operating Risk Controls	121
<i>Description of Process 3 – Selecting Risk Control Strategy.....</i>	<i>122</i>
9. Use Process Maps to Identify Risk and Improve Reliability	123
10. Failure Mode Effects and Criticality Analysis.....	127
11. Chance Reduction Risk Management	133
12. Selecting Maintenance Strategy for Risk Management	141
PROCESS 4 – Introducing Risk Control.....	151
<i>Description of Process 4 – Introducing Risk Control</i>	<i>152</i>
13. Organisation Structure and Teams (A Reliability Based Model).....	154
14. The Accuracy Controlled Enterprise	163
PROCESS 5 – Operating Risk Monitoring and Measuring	185
<i>Description of Process 5 – Risk Monitoring and Measuring</i>	<i>186</i>
15. Process Step Contribution Mapping.....	187
16. Key Performance Indicators	208
17. Mining Your Maintenance History	221
18. Reliability Growth.....	240
PROCESS 6 – Operating Risk Continual Improvement.....	253
<i>Description of Process 6 – Continual Improvement</i>	<i>254</i>
19. Failure Root Cause Removal.....	255
20. Precision Maintenance Skills and Standards.....	263
21. Change Management for Workplace Innovation	269
22. The Plant and Equipment Wellness Vision	272
Glossary	275
Bibliography	295
Index.....	297

Preface

What are the answers that bring enterprise asset management success? I have looked long and wide for them since the early 1990s. I knew they existed. There were companies and organisations renowned for their operational excellence, exceptional equipment reliability and low production costs. Such operations were, and still are, a tiny minority. It is not easy to be the best. I have since learned that ratio is normal; though totally unnecessary. I was fifty two years old when I finally realised what maintenance and asset management were meant to deliver to a business, and how it could be done. That education took me nearly two decades to assemble. Many times I wished that there was one place where I could go to find what was important to know and understand to be a world-class operation. That is why I wrote this book. Equally important to me was to speed the whole process of becoming world-class. No company can afford to wait decades while its managers, supervisors and engineers learn what to do. Even three years is too long. The second purpose of this book was to present a standard methodology to integrate maintenance and asset management best practices throughout a business.

When you write a book on creating maintenance and asset management excellence, you soon realise how much of your thinking is based on what you have read and learnt from previous people's work. Few of the recommended practices and methodologies promoted in this book are my own. Most are the good sense and proven methods of others. Amongst them I have added some new ideas based on my industrial experiences, to provide the missing links that I believe are needed in a standardised process for achieving equipment reliability excellence and maximum life cycle profit.

There are several people to thank who helped me get this far in my never-ending journey of learning and understanding. They provided insight and knowledge that I would have never found without them. Thanks to Raymond Ho at the Swan Brewery, who first showed me the value a great maintenance and reliability professional brings to a business; Peter Brown, from Industrial Training Associates, for the wisdom gained from his many more years of dealing with people and machines in industry than myself; Max Wishaw, for the encouragement to trust myself, and retired Maintenance and Reliability Professor David Sherwin, whose thorough knowledge and no-nonsense approach made me question all that I thought was right, and thereby made things clearer to me.

This book would never have been written without several other people who put up with me. They include Robert Barber and the people at Engineers Media, for whose persistence I will always be indebted; the mysterious reviewer of the first draft copy of the book who liked what was written, even though it was so poorly expressed (and sadly still is), and my wife Susan who lived with years of me typing articles and drawing diagrams that kept me secluded from family life.

There is another group of people to thank, but whose names are too numerous to list, or are now distant memory. It is those people across the world of maintenance, reliability, quality

and asset management who so willingly and dedicatedly shared their experiences, ideas and knowledge with me through their books, articles, discussions, conference presentations, seminars and training courses. You have all helped me to new thoughts and corrected my wrong thinking.

Without doubt I have errors and misunderstandings in this book. As David Sherwin points out in his seminars, “Enterprise Asset Management is a developing discipline still full of theories not yet proven.” I am sure that many of my own ideas will not last long before better methods are found. That is my third hope for the book, that it drives improvement in our understanding of what really does work in making organisations into world-class operations – so then we can all get there.

Mike Sondalini

Introduction

Welcome to the Plant and Equipment Wellness Methodology. Wellness is the journey to finding personal health and well-being. It encompasses discovering the right balance of the mental, physical, emotional and spiritual elements that make our life ideal. Wellness, and the health it brings, is also a wonderful concept to apply to our operating plants and machines. The four constituents to be balanced to get plant wellness and long-term equipment health are capital, culture, people and processes. Processes correspond to the mental, capital the physical, culture the emotional, and people the spiritual element of human wellness.

A prime purpose of this book is to provide a standardised way toward world-class reliability and asset performance. I have adopted W. Edwards Deming philosophy of presenting a proposal to be tested, and by the testing learn how to improve it. This book provides a methodology to maximise plant and equipment reliability that moves an organisation toward operational excellence through 'plant wellness'. Whether you are one person, or a large multi-national group, this book aims to deliver maintenance and reliability success to every user. It is a foundation document for those organisations that use plant, equipment and machinery assets. Included with the book is a CD that contains sample spreadsheets used in the methodology, and a teamwork manual to help introduce the business-wide processes needed of a world-class operation.

Many people will say that there are other ways, simpler ways, to become world-class. It may be so. Whether a methodology is hard or easy is not important; what is important is that it works! Plant and Equipment Wellness is a system of processes to produce sound operating and maintenance strategy and introduce best reliability practices into a business. It is a pathway to becoming amongst the best in the world at getting plant and equipment reliability. Becoming the best requires thinking, planning, systems development, practice and continual improvement. This methodology lets you identify exactly what to do to get maximum equipment reliability, and helps you to do that expertly. Read the book first to gather the concepts it contains. Read it a second time to put the concepts into mental order, and understand their interplay. Use it a third time to map the changes necessary in your operation for it to become a world-class performer.

Plant and Equipment Wellness depends on three key premises. The first is that equipment can only be failure-free if its individual parts do not fail; nothing else matters if the parts break. Parts fail first and then equipment stops. The health of equipment parts fatally impacts equipment reliability. Take care of the parts and the equipment cannot help but be exceptionally reliable. This premise is the cornerstone of production and maintenance success and its achievement will liberate great wealth.

The second premise is that people operate plant and equipment. People introduce 'human factor' and human error issues that can destroy equipment reliability, such as their degree of competence, interest in doing better, amount of curiosity, level of dedication, desire to learn more, and many other entirely normal human traits. The better the 'human factors' are

managed and developed, the more successfully and failure-free will equipment run.

The third premise is that we are working to build a world-class business. A business built of reliable processes that produce desired results which stakeholders and customers are delighted to have. Poor plant and equipment reliability is a business process failure that prevents business success. The more precisely that plant and equipment are used and maintained, the less is the risk of failure, the higher is the quality, the lower is the product price, and the shorter is the delivery time. Customers like that and will buy your product, so making the business successful.

Parts, people and processes; machine, man and method; these are what make our products and services. Each is important to business success and must be encouraged to perform at their best.

Figure i represents where Plant and Equipment Wellness sits amongst the methodologies available for reliability growth, and shows the direction that it aims to take a business.

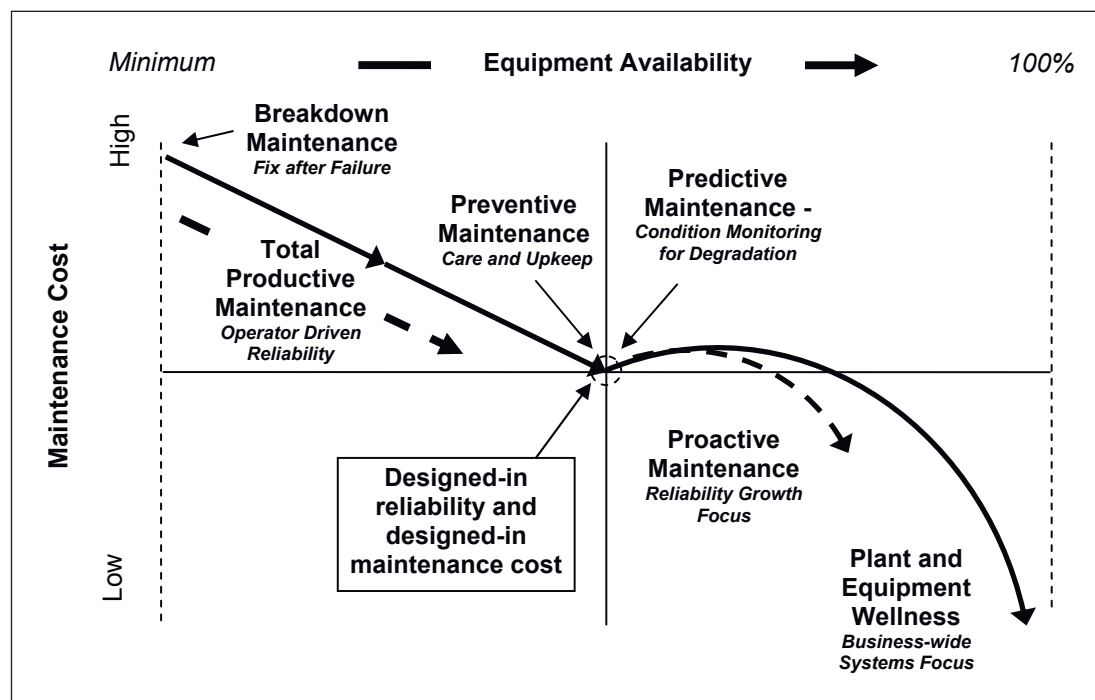


Figure i – The Journey to Plant and Equipment Wellness.

Ensuring equipment parts are always in good health is Maintenance Management. Developing systems and processes that ensure people and equipment work well together for the benefit of the business is Enterprise Asset Management. Maintenance focuses on the parts; Enterprise Asset Management focuses on the work processes and the people. The size of your operating profit is the measure of how successfully each is applied. The Plant and Equipment Wellness Methodology combines maintenance management with key elements of enterprise asset management, and adds Lean business process improvement, work quality management and continuous improvement, to produce a systematic and complete approach to getting the best performance from your parts, people and processes.

You can only do world-class work when you understand it fully and you are its master. This book is both an educational tool and a system for achieving world-class asset management. It includes education for its users in what to do and why. You can simply follow its recommendations, but you will have greater satisfaction if you know why what you do works. You are then the master and can apply your knowledge and know-how anywhere to produce

the right results. The book will help you to create a world-class system of plant and equipment reliability. World-class is defined as ‘the best there is’. With the systems and processes you develop and build using this methodology, you will move your operation toward world-class performance. Figure ii is a simple flow diagram of the methodology. It shows the six process steps to create a lifetime of highly reliable plant and equipment. Work through them one after the other. Nothing that you will do in the methodology is difficult. But you must do it. If you do not, you cannot have the results that this methodology can deliver.

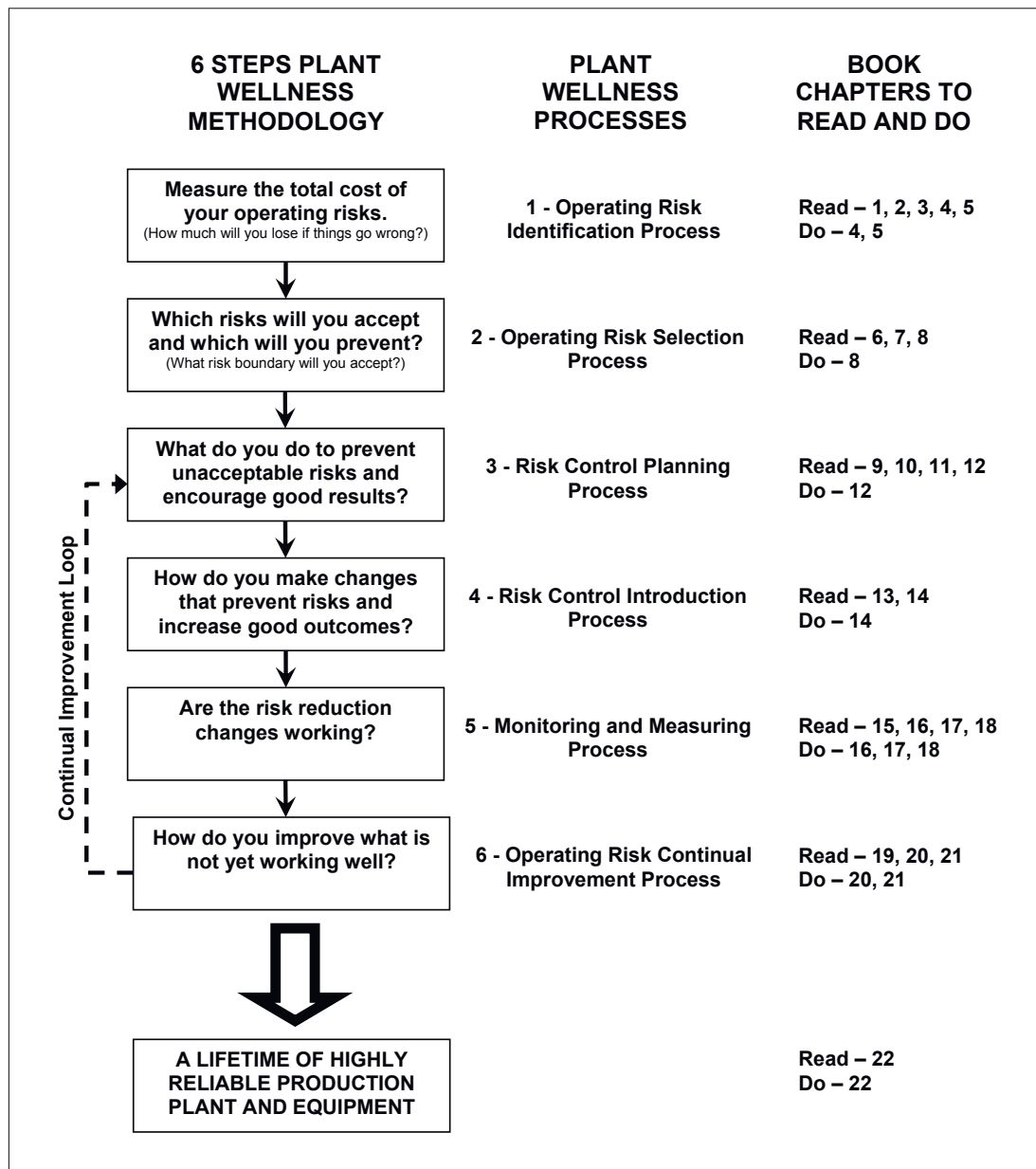


Figure ii – The Plant and Equipment Wellness Maintenance Methodology.

The first purpose of maintenance is to deliver equipment reliability. But you need to know what reliability is before you can ever hope to deliver it with your business systems, methods and practices. Businesses and machinery are series processes and there are only two ways to get high reliability in a series process – exceptional inherent reliability and parallel redundancy. The book starts by simply explaining the basics of series process reliability and the ways it is improved.

The book then moves onto understanding the second purpose of maintenance – risk control. Use maintenance to prevent things from going wrong with production plant and equipment; not to fix failed things. The greater the number of risks you chose to live with, the more failures there eventually must be. You minimise equipment failures by meeting best engineering quality standards, applying stress-reducing operating practices, and by designing-out risks all together.

The greatest risk to high equipment reliability and operational excellence is during the feasibility and design phase of the life-cycle. At this stage, decisions have permanent effects on the number and size of an operation's future risks. The design sets the operational costs. If you want an operation with few problems and low costs, you must make low-risk decisions at design. Once the equipment is in place and operating you are stuck with it. During operation you are limited to only good operating practices and good maintenance practices as risk management strategies. When you design a new plant you are also designing a business. If the original design choices were poor, you will need to revisit them during the operating phase of the life-cycle and correct the design errors.

The next section of the methodology helps you build a maintenance system with the right focus and the right activities that in a short time delivers highly reliable equipment with minimal chance of production losses. You will work through the financial, work management, people management and continual improvement processes you need to have in-place and, most importantly, in-use to create world-class production performance. Along the way, you learn a variety of maintenance management methods, physical asset management approaches, lean thinking and quality system tools to control your equipment reliability and ensure it delivers the world-class results that you want.

Remember that you are building a great business that makes and delivers a great product. For those who want to be in the best of businesses, this methodology is the ideal starting point to develop your engineering asset management and maintenance management systems.

Figure iii is a stylised overview of how a business applies Plant and Equipment Wellness to manage the engineering assets in the business. Take the first step to world class performance and understand how world-class reliability is achieved; good fortune awaits you!

Mike Sondalini
www.lifetime-reliability.com

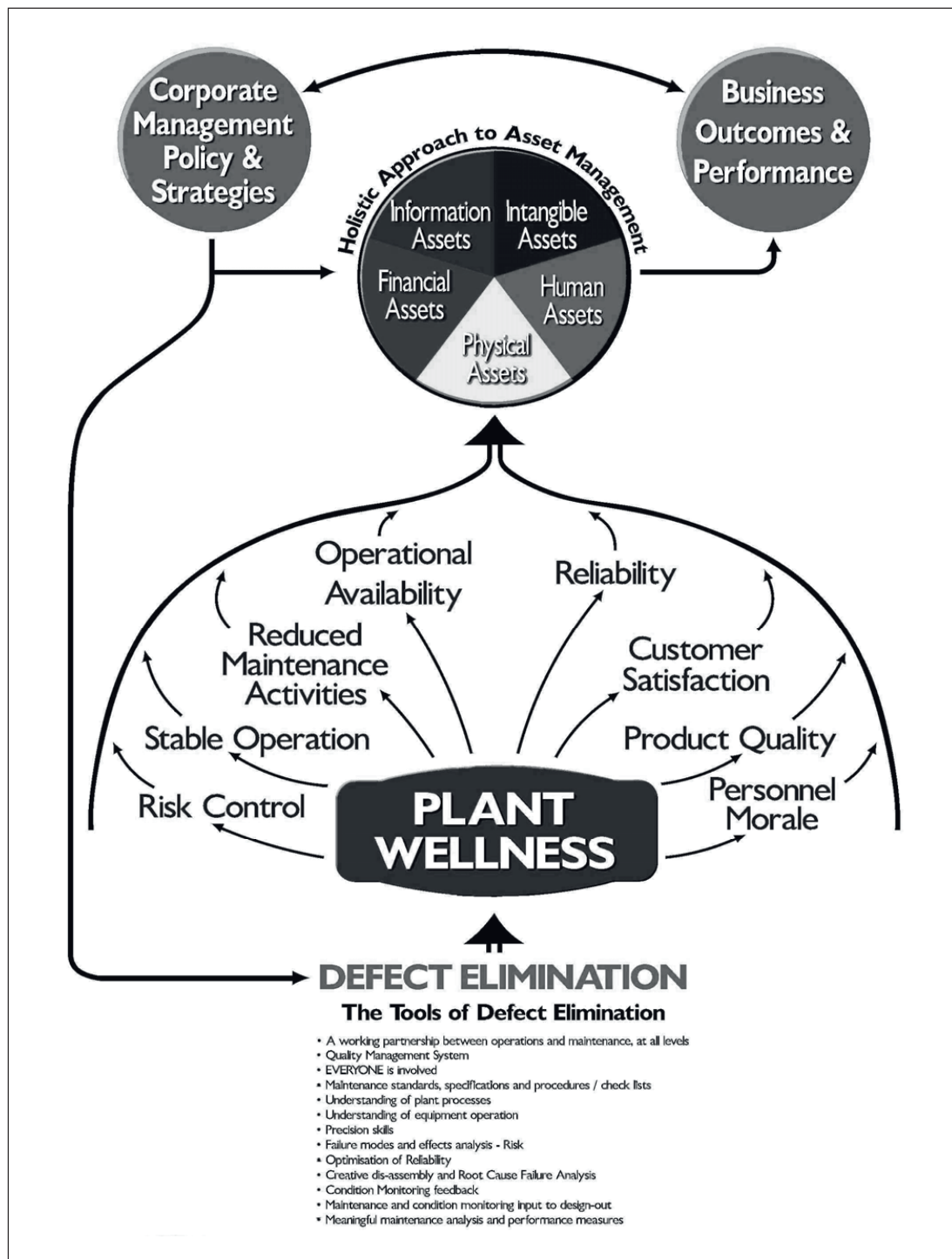


Figure iii – The Purpose and Benefits of Plant and Equipment Wellness. *

* Thank you to Peter Brown of Industrial Training Associates for the Plant and Equipment Wellness concept.