

Chapter 6 Predictive Maintenance Technologies

6.1 Introduction

Predictive maintenance attempts to detect the onset of a degradation mechanism with the goal of correcting that degradation prior to significant deterioration in the component or equipment. The diagnostic capabilities of predictive maintenance technologies have increased in recent years with advances made in sensor technologies. These advances, breakthroughs in component sensitivities, size reductions, and most importantly, cost, have opened up an entirely new area of diagnostics to the O&M practitioner.

As with the introduction of any new technology, proper application and **TRAINING** is of critical importance. This need is particularly true in the field of predictive maintenance technology that has become increasingly sophisticated and technology-driven. Most industry experts would agree (as well as most reputable equipment vendors) that this equipment should not be purchased for in-house use if there is not a serious commitment to proper implementation, operator training, and equipment monitoring and repair. If such a commitment cannot be made, a site is well advised to seek other methods of program implementation—a preferable option may be to contract for these services with an outside vendor and rely on their equipment and expertise.

Table 6.1.1 below highlights typical applications for some of the more common predictive maintenance technologies. Of course, proper application begins with system knowledge and predictive technology capability – before any of these technologies are applied to live systems.

Table 6.1.1. Common predictive technology applications (NASA 2000)

| Technologies | Application | Pumps | Electric Motors | Boiler/Generators | Compressors | Heavy Equipment/Cranes | Circuit Breakers | Valves | Heat Exchangers | Electrical Systems | Transformers | Tanks, Piping |
|-------------------------------------|-------------|-------|-----------------|-------------------|-------------|------------------------|------------------|--------|-----------------|--------------------|--------------|---------------|
| Vibration Monitoring/Analysis | | X | X | X | | X | | | | | | |
| Lubricant, Fuel Analysis | | X | X | X | | X | | | | | X | |
| Wear Particle Analysis | | X | X | X | | X | | | | | | |
| Bearing, Temperature/Analysis | | X | X | X | | X | | | | | | |
| Performance Monitoring | | X | X | X | X | | | | X | | X | |
| Ultrasonic Noise Detection | | X | X | X | X | | | X | X | | X | |
| Ultrasonic Flow | | X | | | X | | | X | X | | | |
| Infrared Thermography | | X | X | X | X | X | X | X | X | X | X | |
| Non-destructive Testing (Thickness) | | | | | X | | | | X | | | X |
| Visual Inspection | | X | X | X | X | X | X | X | X | X | X | X |
| Insulation Resistance | | | X | X | | | | | | X | X | |
| Motor Current Signature Analysis | | | X | | | | | | | | | |
| Motor Circuit Analysis | | | X | | | | X | | | X | | |
| Polarization Index | | | X | X | | | | | | X | | |
| Electrical Monitoring | | | | | | | | | | X | X | |

Chapter 6 Predictive Maintenance Technologies

Michael Rajnik



Chapter 6 Predictive Maintenance Technologies:

Emerging Technologies in Digital Manufacturing and Smart Factories Hassan, Ahdi, Dutta, Pushan Kumar, Gupta, Subir, Mattar, Ebrahim, Singh, Satya, 2023-12-29 Rapid digital transformation is forcing the manufacturing industry to drastically alter its current trajectory for future success. The remarkable convergence of digitalization and manufacturing is reshaping industries ushering in an era known as Industry 5.0. This revolutionary transition has given birth to digital manufacturing and smart factories heralding a new dawn in the way we produce goods. The amalgamation of artificial intelligence, AI, robotics, the internet of things, IoT, augmented reality, AR, virtual reality, VR, big data analytics, cloud computing, and additive manufacturing stands poised to unlock unprecedented avenues in the realm of production. Practitioners, researchers, dreamers, and pioneers all are beckoned to explore the uncharted territories of digital innovation in manufacturing. Emerging Technologies in Digital Manufacturing and Smart Factories spans domains from mechanical and electrical engineering to computer science from industrial economics to business strategy and this book addresses this diverse audience. The book embarks on a comprehensive voyage unveiling the latest evolutions and nascent trends within digital manufacturing and smart factories. From inception to execution from design optimization to predictive maintenance every phase of the manufacturing lifecycle is scrutinized through the lens of cutting edge technologies. Rather than relying exclusively on the theoretical realm this book also ventures into the crucible of real world application offering practical insights drawn from varied industries including automotive, aerospace, and pharmaceuticals. AI-Driven Smart Industrial Technologies Habib, Maki K., 2025-06-26 Industries are being revolutionized through smart connectivity connecting machines and computers to enhance automation, safety, and efficiency. Through the adoption of smart industrial technologies industries are progressing towards greater sustainability. The trends in artificial intelligence, AI, driven technologies point to global advances in quality and productivity. However, challenges still exist in strengthening the collaboration between humans and machines for Industry 5.0 including enhancing human augmentation while still prioritizing employee well-being. AI-Driven Smart Industrial Technologies examines the intersection of advanced technologies and sustainable practices in modern industries in different domains. It provides a distinct perspective on integrating AI, robotics, mechatronics, and Industries 4.0 and 5.0 principles highlighting their collective impact on creating greener, more efficient, and smarter industrial processes. Covering topics such as 3D printing, human-machine collaboration, and cyber-physical systems, this book is an excellent resource for manufacturers, automation professionals, policymakers, technologists, engineers, computer scientists, environmental scientists, professionals, researchers, scholars, academicians, and more. Real-World Applications and Implementations of IoT Aritra Acharyya, Prasenjit Dey, Sujit Biswas, 2025-02-11 This book explores state-of-the-art internet of things, IoT, solutions for energy conservation, security, agricultural advancements, mining, security, healthcare, and environmental protection. This book delves deep into the technology offering a comprehensive analysis, detailed descriptions,

and in depth discussions of recently developed IoT applications With a strong focus on the cutting edge research at a global scale the book combines IoT with artificial intelligence AI shedding light on emerging possibilities and advancements Designed to cater to a broad audience from those with a foundational understanding of science to seasoned engineering and technology experts this book can serve as an essential resource for engineering students and science master s programs Researchers seeking to stay at the forefront of IoT and AI will also find it invaluable

Transforming the Service Sector With New Technology Rana, Varinder Singh, Bathla, Gaurav, Raina, Ashish, Chhabra, Divoy, 2025-05-07 Technology can impact the service sector in a variety of ways It can be used to transform a number of service related businesses including hospitality tourism banking healthcare and others Businesses navigating the rapidly changing landscape of services and technology can benefit from it by using emerging technology to create new services or improve existing ones With the rapid rise in technology the regulatory landscape is changing requiring additional changes to ensure responsible innovation and protect consumers interests Transforming the Service Sector with New Technology strives to stimulate innovation aid in strategic decision making and benefit service industries as a whole It provides valuable information about how technology is impacting and transforming the services sector and insights in responsibly regulating it Covering topics such as customer engagement recovery strategies and technology driven product placement this book is an excellent resource for industry decision makers Industrialists hospitality professionals entrepreneurs policymakers scholars academicians professionals and more

Maintenance, Replacement, and Reliability Andrew K. S. Jardine, Albert H. C. Tsang, 2021-09-15 Since the publication of the second edition in 2013 there has been an increasing interest in asset management globally as evidenced by a series of international standards on asset management systems to achieve excellence in asset management This cannot be achieved without high quality data and the tools for data interpretation The importance of such requirements is widely recognized by industry The third edition of this textbook focuses on tools for physical asset management decisions that are data driven It also uses a theoretical foundation to the tools mathematical models that can be used to optimize a variety of key maintenance replacement reliability decisions Problem sets with answers are provided at the end of each chapter Also available is an extensive set of PowerPoint slides and a solutions manual upon request with qualified textbook adoptions This new edition can be used in undergraduate or post graduate courses on physical asset management

Technology and Safety of Marine Systems J. Wang, 2003-07-22 Traditionally society has regulated hazardous industries by detailed references to engineering codes standards and hardware requirements These days a risk based approach is adopted Risk analysis involves identifying hazards categorizing the risks and providing the necessary decision support to determine the necessary arrangements and measures to reach a safe yet economical operating level When adopting such an approach the abundance of techniques available to express risk levels can often prove confusing and inadequate This highly practical guide to safety and risk analysis in Marine Systems not only adds to the current techniques available but more importantly

identifies instances where traditional techniques fall short. Uncertainties that manifest within risk analysis are highlighted and alternative solutions presented. In addition to risk analysis techniques, this book addresses influencing elements including reliability, Maintenance Decision making, and Human error. The highly practical approach of this title ensures it is accessible to the widest possible audience.

Facility Manager's Maintenance Handbook 2E (PB) Bernard T. Lewis, Richard Payant, 2007-06-01. An Updated Guide to Establishing Cutting Edge Operations and Maintenance Procedures for Today's Complex Facilities. An essential on the job resource. Facility Manager's Maintenance Handbook presents step by step coverage of the planning, design, and execution of operations and maintenance procedures for structures, equipment, and systems in any type of facility. This career building reference provides the tools needed to streamline facility management processes, reduce operational costs, and ensure the effective utilization, maintenance, repair, and renovation of existing physical assets. Now with 40% new information, this Second Edition includes brand new chapters on emergency response procedures, maintenance operations benchmarking, capital and operational budgets management, boiler and steam plant operations, and other vital topics. The only book of its kind to cover both operations and maintenance, the updated Facility Manager's Maintenance Handbook features updated information on mechanical equipment and systems maintenance, the latest fire protection procedures, a comprehensive account of building codes, Guidance on hazardous materials handling. Excellent preparation for the IFMA Certified Facility Manager (CFM) qualification. Inside This State of the Art Facility Management Resource. Part 1 Organizing for Maintenance Operations. Part 2 Facility Operations and Maintenance Operations Plans. Maintenance Plans. Part 3 Equipment and Systems Operations Maintenance o Part 4 Facilities Emergency Preparedness o Part 5 Capital Investment.

Beyond the Hype: Realizing the True Potential of AI Anup Bolshetty, 2023-04-19. Discover the true potential of AI beyond the hype with this insightful and thought provoking book. From healthcare to finance, transportation to manufacturing, explore the many ways in which AI is transforming industries and society, as well as the ethical challenges that must be addressed. Written in an accessible and engaging style, this book is essential reading for anyone interested in the future of technology and its impact on our world.

Engineering Innovation: How Technology Is Transforming Traditional Design Charles Nehme, 2025-11-06. The world of engineering is at a critical inflection point. For decades, our foundational principles from mechanics and thermodynamics to material science have remained constant, but the tools we use to apply them are undergoing a dramatic and accelerating transformation. We are moving beyond simple Computer Aided Design (CAD) into an era defined by intelligent, data-driven systems. This book, **Engineering Innovation: How Technology Is Transforming Traditional Design**, is your essential guide to navigating this new landscape. It is born from the conviction that innovation is not an optional add-on, but a core competency for the modern professional. We explore how emerging technologies like the Internet of Things (IoT), drone-based reality capture, Artificial Intelligence (AI), and additive manufacturing (3D printing) are not just enhancing workflows, but fundamentally redefining what is possible in design.

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Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies Wynn, Martin George,2021-10-15 Companies from various sectors of the economy are confronted with the new phenomenon of digital transformation and are faced with the challenge of formulating and implementing a company wide strategy to incorporate what are often viewed as disruptive technologies These technologies are sometimes associated with significant and extremely rapid change in some cases with even the replacement of established business models Many of these technologies have been deployed in unison by leading edge companies acting as the catalyst for significant process change and people skills enhancement The Handbook of Research on Digital Transformation Industry Use Cases and the Impact of Disruptive Technologies examines the phenomenon of digital transformation and the impact of disruptive technologies through the lens of industry case studies where different combinations of these new technologies have been deployed and incorporated into enterprise IT and business strategies Covering topics including chatbot implementation multinational companies cloud computing internet of things artificial intelligence big data and analytics immersive technologies and social media this book is essential for senior management IT managers technologists computer scientists cybersecurity analysts academicians researchers IT consultancies professors and students

Crist Power Plant Case Study Chetan S. Sankar,P. K. Raju,2000

Della Steam Plant Case Study P. K. Raju,Chetan S. Sankar,2000

Reliability Centered Maintenance (RCM) Neil B. Bloom,2005-12-22 A properly implemented and managed RCM program can save millions in unscheduled maintenance and breakdowns However many have found the process daunting Written by an expert with over 30 years of experience this book introduces innovative approaches to simplify the RCM process such as single vs multiple failure analysis hidden failures analysis potentially critical components analysis run to failure and the difference between redundant standby and backup functions Included are real life examples of flawed preventive maintenance programs and how they led to disasters that could have easily been avoided Also illustrated in detail with real life examples is the step by step process for developing implementing and maintaining a premier classical RCM program Senior management middle management supervisors and craftsmen technicians responsible for plant safety and reliability will find this book to be invaluable as a

means for establishing a first class preventive maintenance program **Technology for the '90s** M. K. Au-Yang,1993

Planning and Managing Reliable Urban Water Systems Robert J. Harberg,1997 This handbook for city planners consultants engineers and public administrators explains what is needed to ensure that a water system will deliver the quality and quantity of water consumers demand Easy to follow sections address reliability goals quality of life water demands public involvement consumer willingness to pay and water shortage prevention *E Source Technology Atlas Series: Drivepower* ,1996

Bottom-line Automation Peter Martin,2006 This newly revised edition helps today s manufacturing companies face the challenges of a global marketplace where every part of the operation must become more efficient to enhance the bottom line Based on the results and conclusions of an applied research project of process manufacturing operations directed by the author Bottom Line Automation presents an overview of more than 30 years of industry trends pointing out the strengths and pitfalls of each The book also explains how manufacturers selected automation technology suppliers for state of the art technological features in their systems rather than for the improvements the technology could offer the manufacturing operation New topics in the book discuss the economic optimization of industrial assets Key findings include the fact that returns on automation investments were rarely if ever calculated In fact accounting systems were not even capable of measuring the performance offered by process automation systems The author explains a strategy for measuring and improving automation system performance for the ultimate goal the bottom line and provides case studies of how such a strategy was implemented in three process manufacturing organizations The author brings more than 30 years of industry experience education and research together in this unprecedented work

Maintenance Engineering Handbook, Eighth Edition Keith Mobley,2014-01-03 Updated modernized digitized and streamlined edition of this classic handbook which has been educating plant and facility professionals in every aspect of maintenance engineering for more than half a century

Integrating Practice, Theory, and Design for Engineers P. K. Raju,2001

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