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THE ENGINEERING JOURNEY TO EXCELLENCE

The Practical Asset Management Framework

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Foreword · Introduction · Chapter One

JOHAN NORTJE

Lead Asset Management Engineer · NJN Consulting

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THE ENGINEERING JOURNEY TO EXCELLENCE

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Books 1–8 of the NJN Consulting Asset Management Series

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ISO 55001:2024 Aligned · 2025 Anthology Edition

Praise for The Engineering Journey to Excellence

"In a discipline crowded with theory, Johan delivers something rare: a practical roadmap any reliability engineer or asset manager can apply on Monday morning. Drawing on more than 30 years at the workstation and in the boardroom, his anthology distils hands-on experience and in-depth research into cutting-edge thinking and technology. The Engineering Journey to Excellence *spans every level from execution to strategy, assisting maintenance practitioners and management alike in mapping a context-sensitive path toward an appropriate level of excellence. Aligned to ISO 55000 principles and widely accepted tools and techniques, it leads the reader directly to the reduced-loss, reduced-risk, reduced life-cycle-cost vision: the* House on the Hill*."*

— Leon Krüger

M.Eng. (Engineering Management)

Asset Management practitioner

"I worked alongside Johan when he was Maintenance Manager at Modikwa Platinum Mine. What he writes here is exactly what he did on the ground — the RCM logic, the FMECA work, the work-management discipline. Not theory. This is the book maintenance managers wish they had on day one."

— Dirk Potgieter

Mechanical Engineer

former colleague at Modikwa Platinum Mine

About This Anthology

This volume is the consolidated edition of Books 1 through 8 of the NJN Consulting Asset Management Series. It is published as a single working reference for practitioners who want the entire Practical Asset Management Framework (PAMF) in one place — from the strategic Operating Model through to the integration, people, and sustainment work that ties it all into a working operation.

Each of the eight books is presented in full, in its original sequence and with its original images, tables and worked examples. A new standalone Foreword introduces the anthology. A new Introduction — "The Engineering Journey to Excellence" — places the eight books on a single seven-gate journey, explaining how each book changes a specific dimension of the operation.

A consolidated Glossary at the back of the volume harmonises terms across all eight books. A single About-the-Author section closes the volume.

Foreword

Maintenance is the most under-appreciated function in industrial operations.

In every plant I have ever walked into — large and small, mature and immature, world-class and reactive — the conversation about maintenance and reliability falls into one of two patterns. Either it is a tactical conversation about firefighting ("why did the bearing fail again?"), or it is a strategic conversation that has lost contact with the plant floor ("we need to mature our asset management framework").

Both conversations miss the point. Maintenance is the operational discipline that determines whether the capital invested in plant and equipment actually delivers a return. It is the difference between a plant that meets its production plan and one that does not. Between a plant that operates safely and one that has incidents. Between a plant that earns the cost of its capital and one that destroys it. And the gap between a top-quartile maintenance organisation and a bottom-quartile one is rarely a question of equipment, technology, or budget. It is a question of system.

The system that produces top-quartile reliability is not a single thing. It is the deliberate integration of eight pillars — strategy, criticality, tactics, work management, defect elimination, performance management, people, and information. Each pillar is a discipline in its own right, with its own theory, its own tools, and its own failure modes. The eight books in this anthology cover those pillars in technical depth, plus the diagnostic toolkit (Lean and Six Sigma) that makes the improvement engine work, and the integration, people, and sustainment work that ties it all into an operating system.

This series exists because, after twenty years of consulting work on industrial and mining sites across Africa, the Middle East, and Asia, I had not found a single reference that translated the standards (ISO 55001, SAE JA1011, ISO 31010:2019, IEC 62740) into the language and tools that working practitioners actually need. The standards tell you what; they rarely tell you how. The academic literature tells you why; it rarely tells you what to do on Monday morning. The vendor literature tells you to buy something. None of these is sufficient when you are the engineer responsible for an asset that has just stopped producing.

So, the question I set out to answer — and that this anthology answers — is simply this: what does a working asset management system actually look like, on a real industrial site, in 2025?

The answer fills eight books because the answer has eight distinct parts, each with its own discipline. But the parts are not independent. They reinforce each other. A criticality framework without a maintenance tactics methodology produces a list. A maintenance tactics methodology without work management discipline produces unfinished work. Work management discipline without defect elimination produces stable mediocrity. Defect elimination without diagnostic tools (Lean and Six Sigma) produces paperwork. And none of it survives without the integration, people, and sustainment work

that ties it all into a working operating system. And none of it survives without an Operating Model — the governance system that aligns the people, processes, and technology behind the rest.

This is the system. This anthology is the manual.

If you are a plant engineer, a maintenance supervisor, a reliability engineer, an asset manager, or an operations leader — read this volume in sequence. Mark it up. Argue with it. Apply the parts that fit your operation, and discard the parts that do not. The framework is more important than any single tool.

And remember: the goal is not the framework. The goal is reliability. Everything else is a means to that end.

Johan Nortje *Lead Asset Management Engineer · NJN Consulting*

Unified Standards & Methodology Disclaimer

Independent Commentary and Methodology: This publication is an independent work of engineering commentary and practical implementation. It is not an official publication of, nor is it endorsed by, the International Organisation for Standardisation (ISO), the International Electrotechnical Commission (IEC), or SAE International.

Compliance and Alignment: The Practical Asset Management Framework (PAMF) in this anthology is designed to align with the rigorous requirements of:

ISO 55001:2024 (Asset Management Systems)

SAE JA1011 / JA1012 (Reliability-Centered Maintenance Criteria)

ISO 31010:2019 (Risk Management – Risk Assessment Techniques)

Notice of Non-Reproduction: This work provides original tools, processes, and "The Circular Engine" continuous improvement model to *operationalise* these standards. It does not reproduce the official text of these standards. For formal certification or audit-level compliance, practitioners must obtain official copies of the relevant standards from the respective governing bodies (www.iso.org, www.sae.org). Reference to these standards is for descriptive purposes to situate this methodology within the global industrial engineering landscape.

Introduction

The Engineering Journey to Excellence

The HOTH Framework — House of Technical Health

Why a House?

Industrial reliability literature is full of pyramids and pillars. The Toyota Production System has its house. The Society for Maintenance and Reliability Professionals has its five pillars. ISO 55001 has its plan-do-check-act loop. Each of these is useful, and each captures a real truth about how reliable operations are built. None of them, in my experience, captures the most important truth: that an industrial operation is not a structure you build once. It is a system you sustain.

A house is a useful metaphor because a house has three properties that a reliable plant also has. First, it has foundations — the parts you cannot see, but on which everything else rests. Second, it has a structure — load-bearing walls and frames that hold the house up. Third, it has a roof — the visible outcome that everyone in the house benefits from. Take away any one of the three, and the house ceases to function as a house.

The House of Technical Health (HOTH) is a metaphor for the reliable industrial operation. The roof is the operational outcome — production, safety, cost, and licence to operate. The structure is the seven gates of the engineering journey, each of which corresponds to one of the first seven books in this anthology. The eighth book covers the integration of those seven, the people who run the system, and the sustainment discipline that holds the gains. The foundation is the operating model. The HOTH framework is not new in its components — every book on industrial reliability covers some subset of these topics. What is new is the framing: that an industrial operation is a journey, that the journey has gates, and that the gates must be passed in sequence to deliver a reliable result.

The Roof: What "Excellence" Actually Means

The word "excellence" is overused in management literature. In an industrial context, excellence has a specific, measurable meaning. An excellent operation delivers four outcomes simultaneously, sustained over time:

- Production at planned rate, planned tonnage, and planned specification.
- Safety — striving for zero recordable incidents, zero lost-time injuries, and zero fatalities
- Cost discipline — operating cost per unit at or below industry top-quartile.
- Compliance — full alignment with regulatory and standards-based obligations, including ISO 55001:2024.

The conjunction "simultaneously" is the difficult part. Many plants achieve any one of these outcomes for a period. Few achieve all four, year after year. The plants that do — the top quartile of global operations — share one characteristic. They have built a complete system. The HOTH framework describes that system.

The Foundation: The Operating Model

Before the journey begins, there must be a foundation. In the HOTH framework, the foundation is the Operating Model — the governance system that aligns people, processes, and technology behind the technical work that follows. Without an Operating Model, the rest of the journey produces tactics without strategy. Procedures without ownership. Activity without outcome.

Book 1 — The Operating Model — is the foundation chapter of this anthology. It is not the end-state. It is the precondition. Read it first. Internalise it. Then continue.

The Seven Gates of the Journey

The journey from a reactive maintenance organisation to a top-quartile reliability operation has seven gates. Each gate is a specific transformation in how the plant thinks and works. Each is the subject of one book in this anthology — Books 1 through 7. The eighth book then covers the integration, people and sustainment work that turns the seven gates into a working system. The gates must be passed in sequence — although they reinforce each other, each one depends on the gate before it.

Gate 1 — Establishing the Operating Model (Book 1)

The first gate is governance. Before any technical work happens, the operation must agree on the system. Who is accountable for asset performance? How are decisions made? What is the line of sight from strategy to plant-floor activity? How does Plan-Do-Check-Act actually work in this organisation?

The Operating Model establishes the framework. It defines the eight pillars of the Practical Asset Management Framework. It assigns roles and responsibilities. It introduces the cross-functional team model and the RACI matrix that prevents "everyone's job is no one's job." It introduces the Six-Step Work Management process and the maturity model that lets you measure your progress. And it positions the operating model relative to ISO 55001:2024 — not as a paper compliance exercise, but as a working management system.

The transformation: from individual heroics to a systematic operation.

Gate 2 — Knowing What Matters (Book 2)

The second gate is asset criticality. Once the Operating Model is in place, the next question is: where do we focus? Every plant has thousands of assets. They cannot all receive the same level of maintenance attention. Some assets, if they fail, will cost the operation millions of dollars and put people at risk.

Others, if they fail, will be replaced from the storeroom in twenty minutes. The plants that recognise this difference, and act on it, outperform the plants that do not.

Asset criticality is the risk-based classification methodology that ranks every asset by the consequence × likelihood of failure. It produces an A/B/C/Low classification that drives every downstream decision — what maintenance tactic to apply, what spares to hold, what work to prioritise, what defects to investigate, what KPIs to monitor. Without criticality, the rest of the framework has no focus.

The transformation: from treating all assets equally to focusing on the assets that matter.

Gate 3 — Choosing the Right Maintenance (Book 3)

The third gate is maintenance tactics. Knowing which assets matter is not enough; you must also know what to do for each one. Should this asset be run to failure? Maintained on a fixed time interval? Monitored continuously and intervened only when condition deteriorates? Redesigned to remove the failure mode entirely? The answer depends on the asset, the failure mode, the consequences, and the economics — and there is a structured methodology for finding it.

Reliability-Centered Maintenance (RCM), Failure Mode Effects and Criticality Analysis (FMECA), the P-F curve, the Bathtub curve, Weibull analysis — these are the tools that turn maintenance from habit into evidence. Book 3 walks through them in technical depth and shows how they translate into task lists, maintenance plans, and strategy assignments in SAP PM. The output is a maintenance programme that does what is needed and nothing more.

The transformation: from maintaining on habit to maintaining on evidence.

Gate 4 — Executing the Work (Book 4)

The fourth gate is work management. By Gate 3, the plant knows what to do. Gate 4 is about doing it — reliably, on schedule, in a way that produces the data the rest of the system needs. This is the operational discipline that separates the top-quartile plants from the rest. The technical strategy is the same; the difference is the discipline of execution.

Work management is the operating system of maintenance. It includes the six-step process from notification through close-out, the weekly meeting rhythm, the priority framework, the planner's standards, the schedule compliance and PM compliance KPIs, and the management of shutdowns and outages. The defining principle, lifted directly from the book: if it does not add value to the bottom line, do not do it.

The transformation: from chaotic execution to predictable, value-adding work.

Gate 5 — Eliminating Recurring Defects (Book 5)

The fifth gate is defect elimination. By Gate 4, the plant is doing the right work, on time, with discipline. But some failures keep coming back. The bearing that has been replaced six times this year. The valve

that fails every shutdown. The instrument that drifts out of calibration every month. These are recurring defects, and they consume the plant's budget, attention, and credibility. Defect elimination is the structured process for finding the root cause of these recurring failures and removing them — permanently.

The five-step DE process. Top-down and bottom-up streams. The Defect Register as the single source of truth. RCA methods (5 Whys, Fishbone, FMEA, fault-tree). Pareto and Jack Knife analysis. The defining word, again from the book: permanently. A DE outcome that does not survive the next ninety days of operation has not been completed.

The transformation: from re-fixing the same things to fixing them once.

Gate 6 — Knowing It's Working (Book 6)

The sixth gate is asset performance management. By Gate 5, the plant has a complete technical and operational system. The final question is: how do we know it is working? Without a measurement system, the rest of the framework operates on faith. With one, every part of the operation can be tested, debated, and improved on the basis of evidence.

Asset performance management is the measurement system. It includes the closed-loop performance management process, OEE as the master metric (with the Three-Tier framework), the complete KPI catalogue with formulae and world-class benchmarks, the Twin Lenses principle that pairs performance KPIs with theory KPIs to spot fragile gains before they collapse, and the KPI Cascade by Role that ensures the right metrics reach the right decision-makers at the right cadence. ISO 55001:2024 Clause 9.1 — Monitoring, measurement, analysis and evaluation — is operationalised here.

The transformation: from hoping it's working to knowing it's working.

Gate 7 — Continuous Improvement Forever (Book 7)

The seventh gate is the diagnostic discipline of Lean and Six Sigma. By Gate 6, the plant has visibility of how it is performing. The seventh gate gives it the tools to keep improving — forever. SIPOC scopes the problem before the investigation begins. DMAIC structures the improvement project from definition through control. The Eight Wastes (DOWNTIME) catalogue the losses that production and maintenance leak every day. Value Stream Mapping, 5S, Kaizen events, Poka-Yoke, control charts, and process capability analysis — these are the working tools of a plant that does not stop improving.

Defect Elimination without Lean and Six Sigma tends to become reactive maintenance with extra paperwork. Lean and Six Sigma without Defect Elimination tends to become a training programme. The combination — applied with discipline, in sequence — is what delivers durable improvement.

The transformation: from a stable system to a continuously improving one.

How to Use This Anthology

This anthology is structured for two kinds of reader.

If you are reading the framework for the first time — read in sequence. Books 1 through 7 are designed to be read in order, because each gate depends on the gate before it. The transformations compound. Skipping ahead is possible, but it produces fragmentary understanding. The system is the point.

If you are using the anthology as a working reference — read by gate. Each book is self-contained. You can return to Book 3 when you need maintenance tactics, to Book 5 when you need a Defect Elimination process, to Book 6 when you need a KPI definition, to Book 8 when you need integration, capability or sustainment guidance. The consolidated Glossary at the back of the volume harmonises the terminology across all eight books.

In either mode, the goal is not to memorise the framework. It is to apply it. Mark up the pages. Argue with the assertions. Substitute your CMMS for SAP PM where appropriate. Adapt the criticality scale to your industry. The framework is a starting point, not an end-point.

The journey is the system. The system is the journey. Begin.

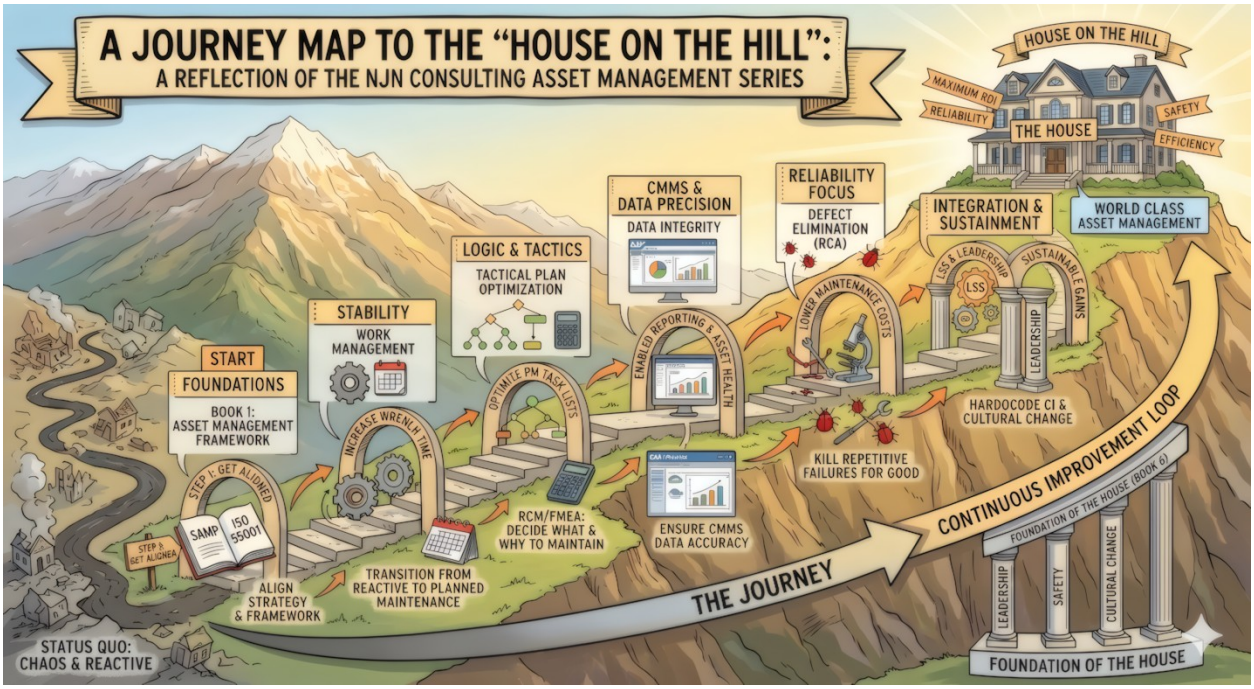

Table of Contents

The eight books of this anthology, with chapter pages.

FRONT MATTER

BACK MATTER

Book 1 — The Operating Model

A Practical Guide to Asset Management Organisation, Governance & Continuous Improvement

Book 1 - The Operating Model

Johan Nortje
The Operating Model | NJN Consulting Asset Management Series **ISO 55001:2024 Aligned**

NJN CONSULTING ASSET MANAGEMENT SERIES **BOOK ****1**
THE OPERATING MODEL A Practical Guide to Asset Management Organisation, Governance & Continuous Improvement

ISO 55001:2024 Aligned Written by Johan Nortje | Lead Asset Management Engineer NJN Consulting (MD) | 2025 Edition **Book 1 of the 8-Book Asset Management Series**
Precision. Strategy. Reliability.

FOREWORD
This eBook is the first in an eight-part Asset Management Series published by NJN Consulting. Where Books 2 through 8 address Asset Criticality, Maintenance Tactics, Work Management, Defect Elimination, Asset Performance Management, Lean and Six Sigma, and Integration, People and Sustainment in technical depth, this volume establishes the foundation — the Operating Model that makes everything else possible.
No maintenance strategy succeeds without a clear operating model. You can have world-class maintenance tactics, sophisticated condition monitoring, and the best planners in the industry — but if roles are unclear, processes are not standardised, and people are not aligned to shared objectives, performance will remain inconsistent and reactive.
How This Book Fits in the Series Book 1 — The Operating Model (this book): The governance framework — roles, PDCA, work management, and performance metrics. Book 2 — Asset Criticality: Risk-based classification that drives every downstream decision. Book 3 — Maintenance Tactics: The technical methodology for selecting the right maintenance strategy per asset. Book 4 — Work Management: The operational execution engine — planning, scheduling, and continuous improvement. Book 5 — Defect Elimination: The structured process for eliminating recurring failures permanently. Book 6 — Asset Performance Management: The measurement, KPI and reporting framework that proves the system is working. Book 7 — Understanding Lean and Six Sigma: SIPOC, DMAIC and process-defect identification for continuous improvement. Book 8 — Integration, People, and Sustainment: The integration logic, capability requirements, and sustainment discipline that turn the technical pillars into a working operation.

Chapter 1: What is an Operating Model?

An Operating Model is the framework that defines how an organisation delivers value through its people, processes, and systems. In asset-intensive industries — mining, utilities, manufacturing, and process plants — the operating model answers a fundamental question:

The Core Question "How do we ensure that our physical assets deliver the performance required to achieve our business objectives — safely, reliably, and at the lowest sustainable cost?"

The operating model defines the structure within which all asset management activities occur. It is not a document — it is a living system of aligned roles, consistent processes, enabling technology, and accountable people.

1.1 The Three Pillars of an Operating Model

Every effective operating model rests on three interdependent pillars. Weakness in any one of them undermines the entire system.

Figure 1: The three pillars of an Operating Model — People, Processes and Technology.

The ISO 55001:2024 standard recognises this relationship explicitly: asset management is achieved through an integrated system where people, processes, and technology work together to realise value from physical assets.

1.2 Why the Operating Model Matters

Operations that lack a defined operating model exhibit consistent failure patterns:

- Reactive, firefighting maintenance culture — crisis-driven rather than planned
- Poor schedule compliance — work is identified but not executed on time
- Siloed departments — maintenance and production work against each other
- Inconsistent data quality — decisions made without a single version of truth
- High maintenance cost per unit produced — waste from poor work preparation

- Safety incidents linked to equipment failures — unplanned work is unsafe work

Conversely, organisations with a mature operating model demonstrate measurable advantages:

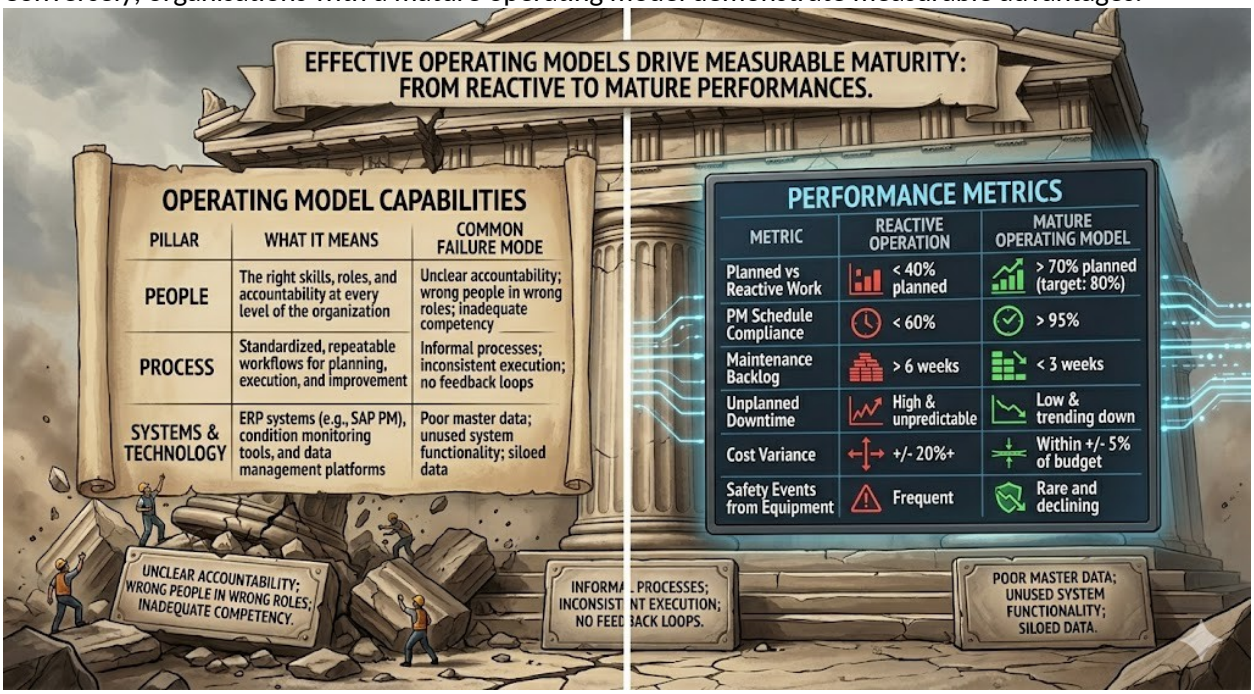

Figure 2: Symptoms of operations without a defined Operating Model.

1.3 The Operating Model in the Asset Management Context

Within a typical mining/plant framework, the Operating Model and the Practical Asset Management Framework (PAMF) are tightly coupled. The PAMF provides the technical "HOW" — the methodology for asset care. The Operating Model provides the governance "WHO, WHEN, and WHERE" — defining how those methodologies are executed across the organisation.

Key integrations between the Operating Model and the PAMF include:

- Maintenance Tactics = Service Strategy component of Operational Planning
- Work Management = identical in both frameworks, with added integration for scheduling production and maintenance activities
- Defect Elimination = technical sub-component of Analyse and Improve
- Asset Criticality = foundation for prioritising all other activities

Key Principle The Operating Model and Asset Management Framework must be implemented in close coordination. Separate or misaligned rollouts create confusion, duplication, and lost value. Both frameworks share the same goal: safe, reliable, cost-effective asset performance.

Chapter 2: ISO 55001:2024 — The Standard Behind the Model

ISO 55001:2024 is the international standard for Asset Management Systems. It was significantly updated in 2024 to strengthen alignment between strategic intent and operational execution — what practitioners refer to as the "line of sight."

2.1 The ISO 55000 Family of Standards

You've read the opening.

Continue the full 261-page anthology —
all eight pillars of the Practical Asset Management Framework,
with every worked example, figure and checklist.

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