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# EXECUTIVE REPORT

## FOR CEO'S, EXECUTIVES AND SENIOR MANAGERS IN INDUSTRY AND MANUFACTURING

**Utmost operating profits, lowest maintenance costs, world class reliability, & outstandingly effective physical asset management the Plant Wellness Way**

***Let a Plant Wellness Way EAM System-of-Reliability halve your Annual Maintenance Costs***

In the Plant Wellness Way (PWW) you do nothing to your business until you have total confidence that what you do, and how it will be done, will be extraordinarily successful.

We have learnt from decades of experience that it is vital to first design and test business changes. Otherwise you use a trial and error approach that surely brings many problems, and costs you far more expense than necessary. Making changes by guesswork may even cause unintended disasters and catastrophic losses.

When you use PWW to make a maintenance, reliability or operating asset management improvement you first design the new solution properly, and then test the design will produce good results in your operation. This white paper takes you through the use of the Plant Wellness Way to improve an industrial operation from average results to world class maintenance, reliability, and physical asset management performance.

## 1. How the Plant Wellness Way Works

The Plant Wellness Way is an enterprise asset management methodology designed on reliability engineering and risk elimination principles used to get high reliability operating equipment. Figure 1.1 shows you the level of uptime performance Plant Wellness Way is designed to deliver compared to the other available production equipment maintenance methodologies.

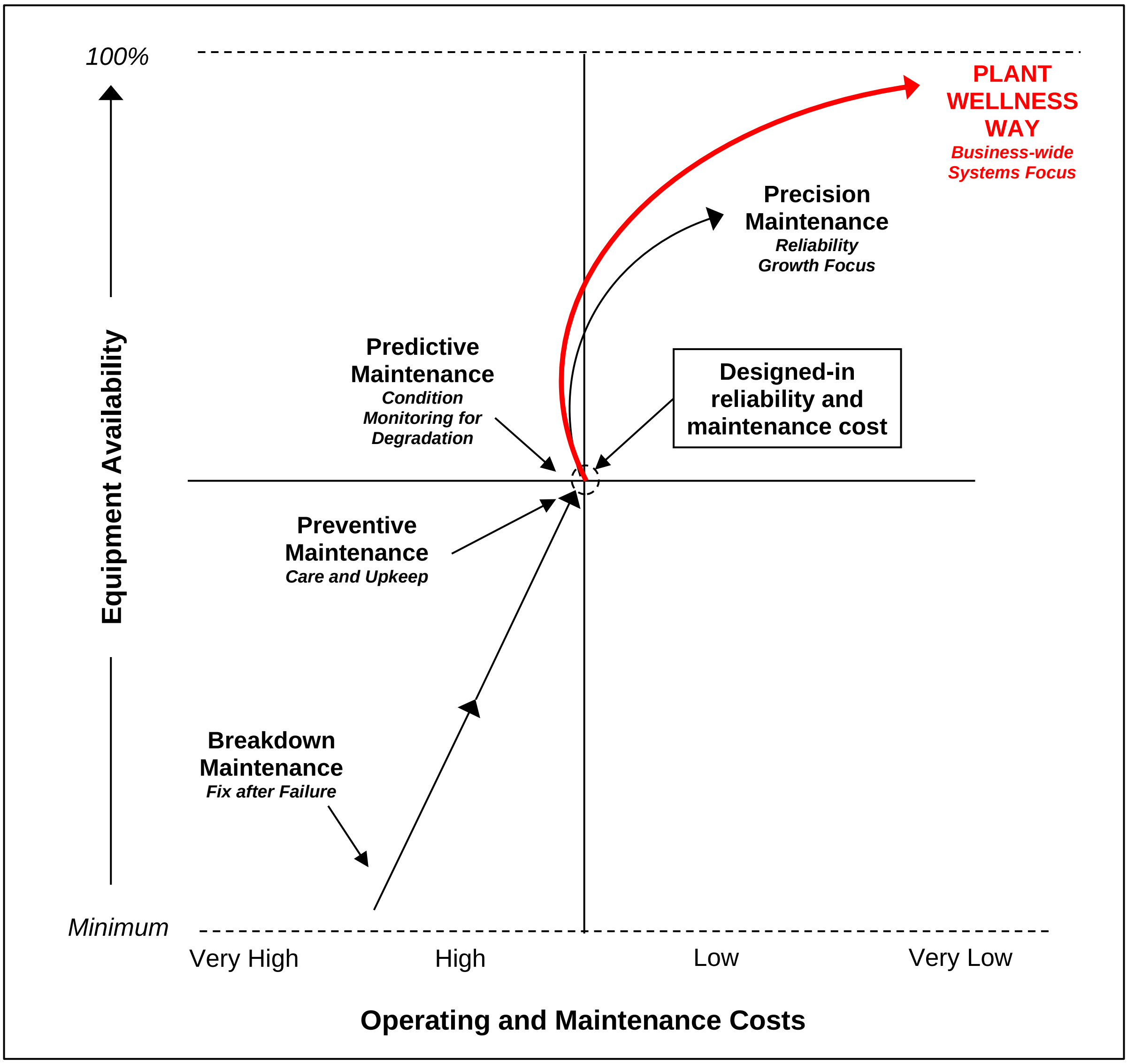


Figure 1.1—Climb the Heights of Enterprise Asset Management Success

## 1.1. Maintenance Cannot Deliver World-Class Reliability

Figure 1.2 is representative of the mix maintenance strategies available and the plant uptime they can achieve. It hints of the answer to getting highly reliable plant and equipment.

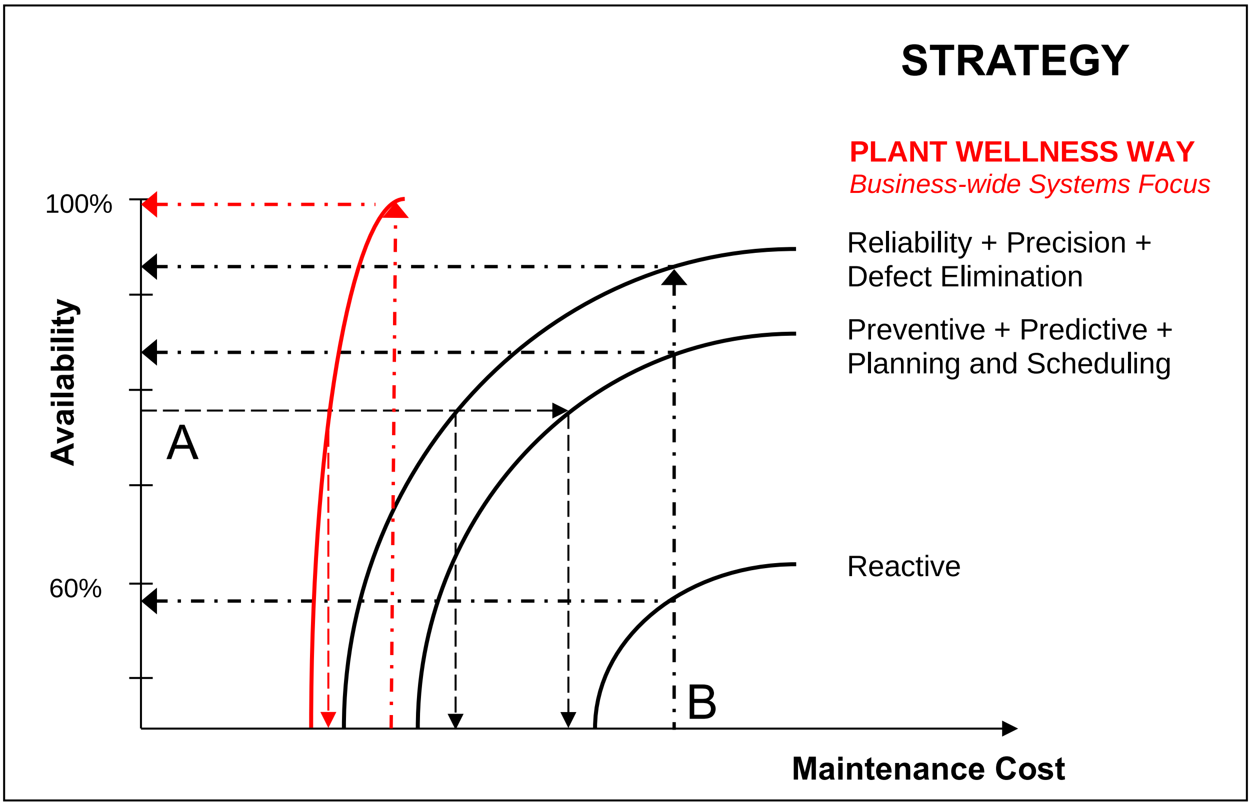


Figure 1.2—Availability and Maintenance Cost is a Result of Asset Management Strategy

Point ‘A’, near to 80% Availability, can never be reached by reactive operations. These unfortunate businesses are doomed to always have costly maintenance and poor production performance. A well-developed, combined Preventative, Predictive and Planned Maintenance strategy might approach 90% Availability. They will get better production performance and lower maintenance costs. Using Reliability-growth, Precision Maintenance and Defect Elimination strategies brings greater uptime and operating profit margin. The Plant Wellness Way surpasses all of them, because you first build a complete life cycle business system for utmost operating profits that works right from the first day. Point ‘B’ shows that availability and, by implication equipment reliability, has little to do with how much money you spend on maintenance. It is the choice of strategy that matters most. For identical maintenance costs the strategy selected has the greatest effect on production and maintenance performance.

Figure 1.3 highlights that the Plant Wellness Way also gets you to world class performance far faster than any other viable strategy. Because it's a fully designed business system you install the best methods and most effective solutions by design and you get to Operational excellence success much faster.

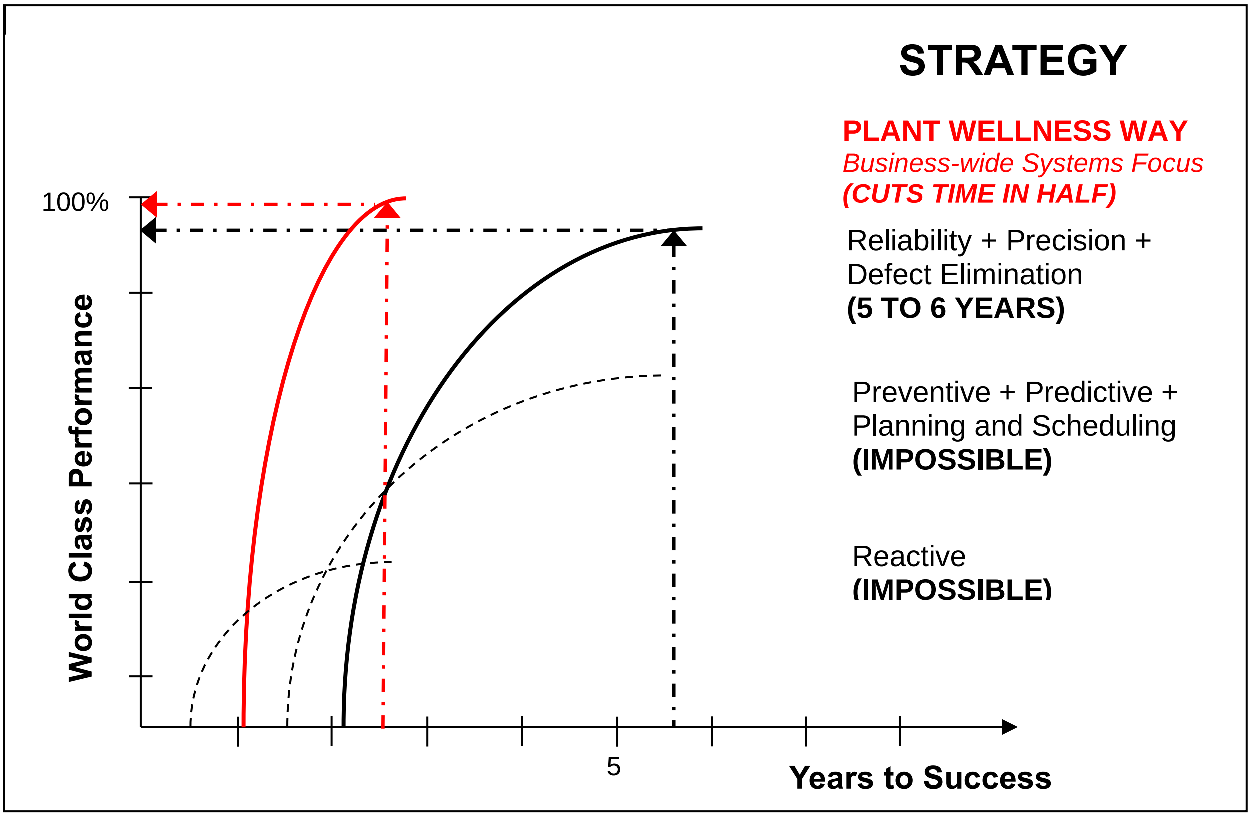


Figure 1.3—Speed to World Class Performance is a Result of Asset Management Strategy

The Plant Wellness Way produces highly reliable plant and machinery because it identifies how to create individual equipment component health and ensures the required means and actions are done. When machine parts work at least material-of-construction stresses they reach their highest reliability and the equipment becomes most reliable for its entire service life. The Boardroom decision to use Plant Wellness Way as a company's asset management and reliability creation methodology ensures its business processes and reliability practices will create and bring lasting operational and maintenance success. Plant Wellness Way identifies and removes operational risk to get utmost equipment reliability, plant availability and asset utilization so production unit cost is safely minimized. The proprietary 6-step IONICS methodology used in the Plant Wellness Way eliminates risks and puts reliability success into life cycle processes. The best solutions become standard operating practice and your people are trained to use and implement them correctly.

The enterprise asset management, maintenance and reliability methodology used in the Plant Wellness Way is called the Stress-to-Process Model. Figure 1.4 introduces the 'Stress-to-Process' model for asset management success. With it you engineer and install world-class reliability in your company. The 'Stress-to-Process' life cycle management methodology lets you discover exactly how to produce world-class maintenance and reliability and imbeds the best right solutions into your organization's processes. It is a scientifically based model for designing and building the least cost, least manpower and most successful enterprise asset management system. It gets you to build and use the life cycle processes and practices that create healthy, long-lived parts and so create outstandingly reliable equipment.

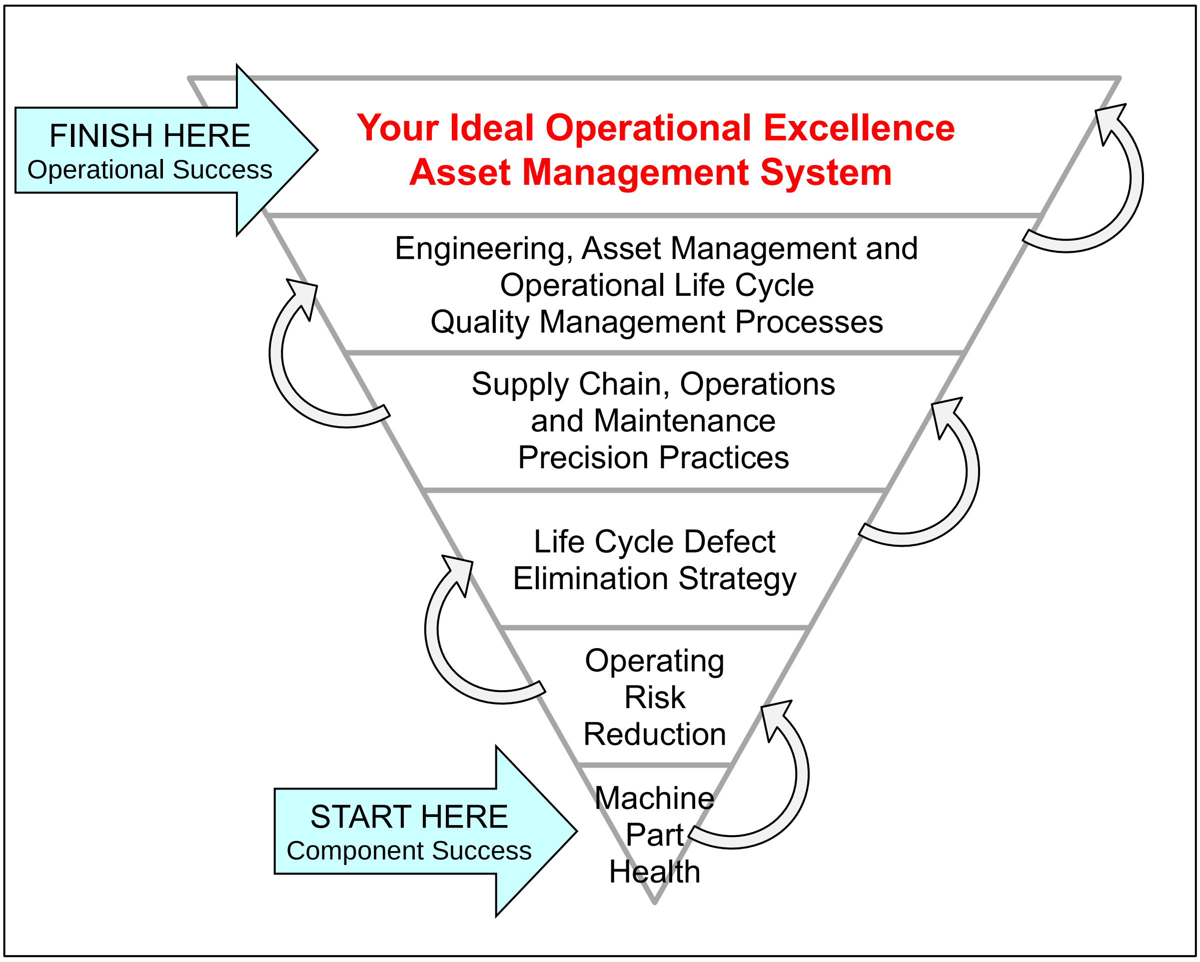


Figure 1.4—Atomic Stress to Business Process Asset Management Model

Figure 1.5 is a more detailed view of the bottom-up Plant Wellness Way Stress-to-Process Model. From component stresses you design the business processes you use to reach the pinnacle of world class plant and equipment reliability.

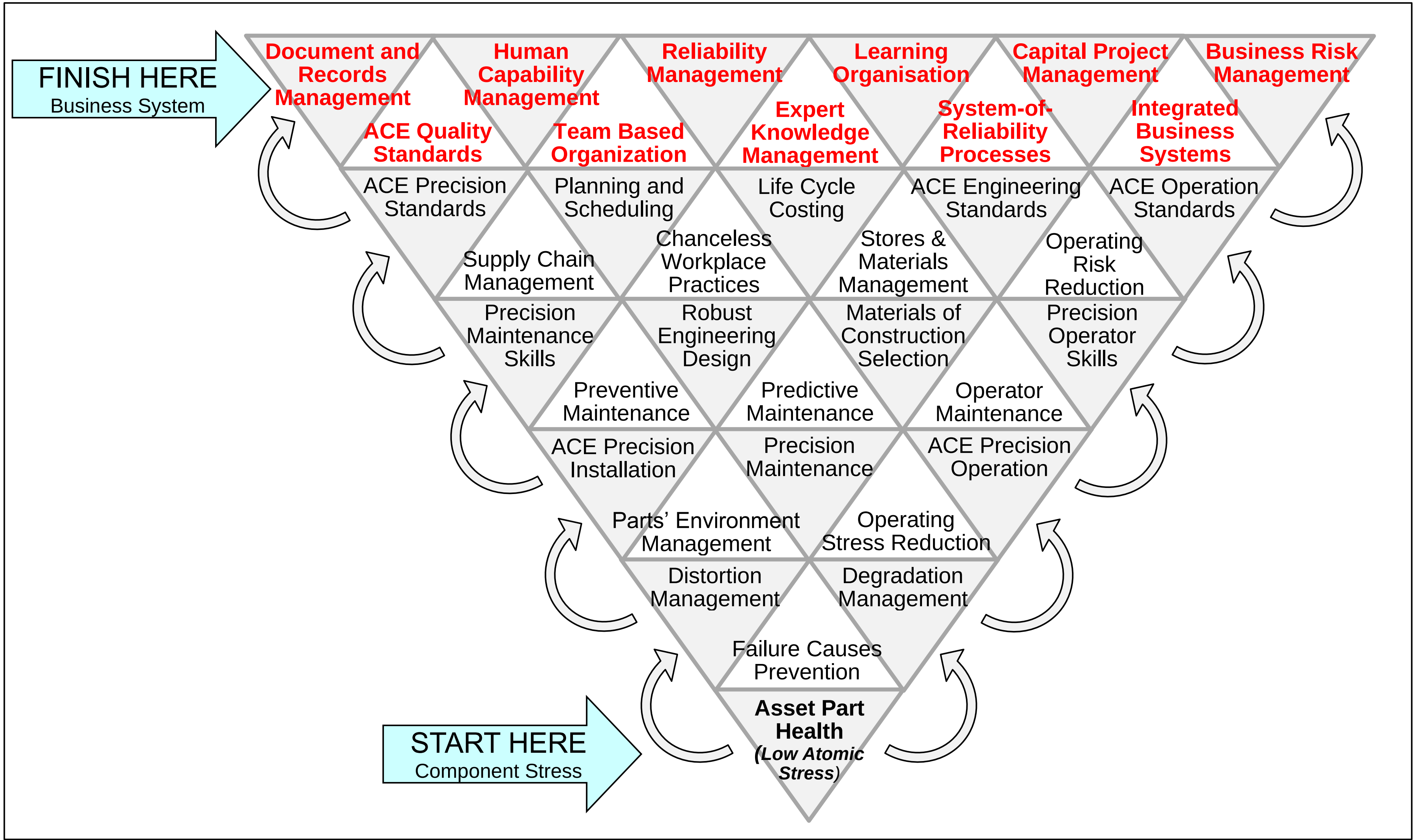


Figure 1.5—The Plant Wellness Way Up To the Top of World Class Maintenance, Reliability and Enterprise Asset Management

## 1.2. Plant Wellness Way Methodology

All physical asset failures can be grouped into one of two reasons—microstructure distortion or atomic degradation. Distortion causes parts to suffer such high stress or fatigue that it fails their microstructure. Whereas when a part degrades the material-of-construction is attacked by elements in the contacting environment. Physics of Failure methods let us analyse equipment for situations that cause a part's atomic structure to disintegrate and/or its microstructure to suffer excessive stress. You identify potential causes of microstructure distress and then institute the fewest life cycle activities needed to keep each part at its highest reliability so your operating plant and equipment reaches the highest availability.

Using the 'Stress-to-Process' framework you derive the activities to put into your financial management, project engineering, supply chain, maintenance, and operational management processes to prevent the deformation and degradation of each part in your machines and equipment. You engineer a life cycle asset management system—a system-of-reliability—to deliver parts with a long, failure-free life. With the right processes from bottom to top in your company it naturally gets the world-class asset maintenance and reliability results needed for Operational Excellence.

The five foundational business and reliability understandings used to improve equipment reliability the Plant Wellness Way are listed below.

1. The costs of defect and failure are directly connected to the number and size of risks carried by your business—the more risks tolerated, the greater the opportunity for errors and the higher the costs, losses and wastes that must eventually accrue.

2. Failure events do not only have localized consequences, rather failure costs surge company-wide. Your business always pays every cent for all the costs of its failures.
3. All organizations, machines and work are series processes and the success of every series process depends on the success of each individual step.
4. There are natural physical limitations in the materials used to make your plant and equipment. Throughout their microstructure the stress from imposed loads must always stay well within the elastic deformation range of the materials-of-construction.
5. Variation away from the standard for best results produce defects that create failures. For world class reliability only use processes throughout a component's life cycle with natural variation always within the outcomes that deliver excellence.

Figure 1.6 is an overview of applying the Plant Wellness Way methodology. It is the structured approach you follow to arrive at the right design, operating and maintenance strategies for maximising equipment reliability. The methodology takes a life-cycle view of plant and equipment and recognizes that a lifetime of high equipment reliability depend on the reliability of the individual parts in a machine. It helps you to develop the right engineering, project selection, plant construction, operational and maintenance plans and practices for failure-free plant and equipment.

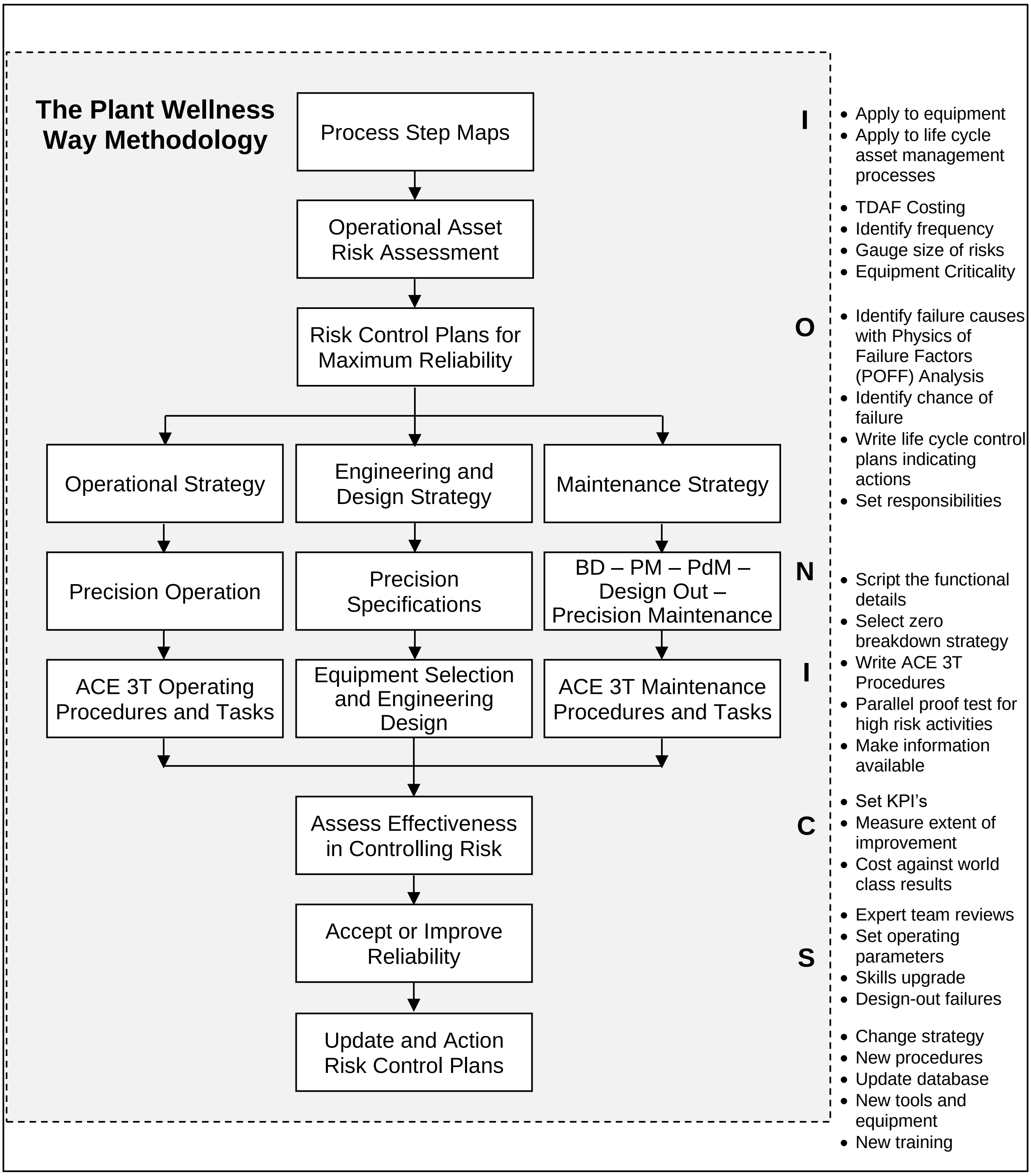


Figure 1.6—More Operating Profits by Remove Operating Risks the Plant Wellness Way

## 2. Overview of the Six IONICS Processes

IONICS is a 6-step process defined by: **I**dentify risks, **O**rder by importance, **N**umerate options, **I**ntroduce solutions, **C**ontrol processes and **S**ynthesize new ideas. Each step has a custom logic tree to follow. IONICS is used to develop life cycle asset management, operational and maintenance management strategy and activities needed for world class reliability and operational excellence. Figure 1.7 shows you the steps in IONICS process design for world class maintenance, reliability and enterprise asset management.

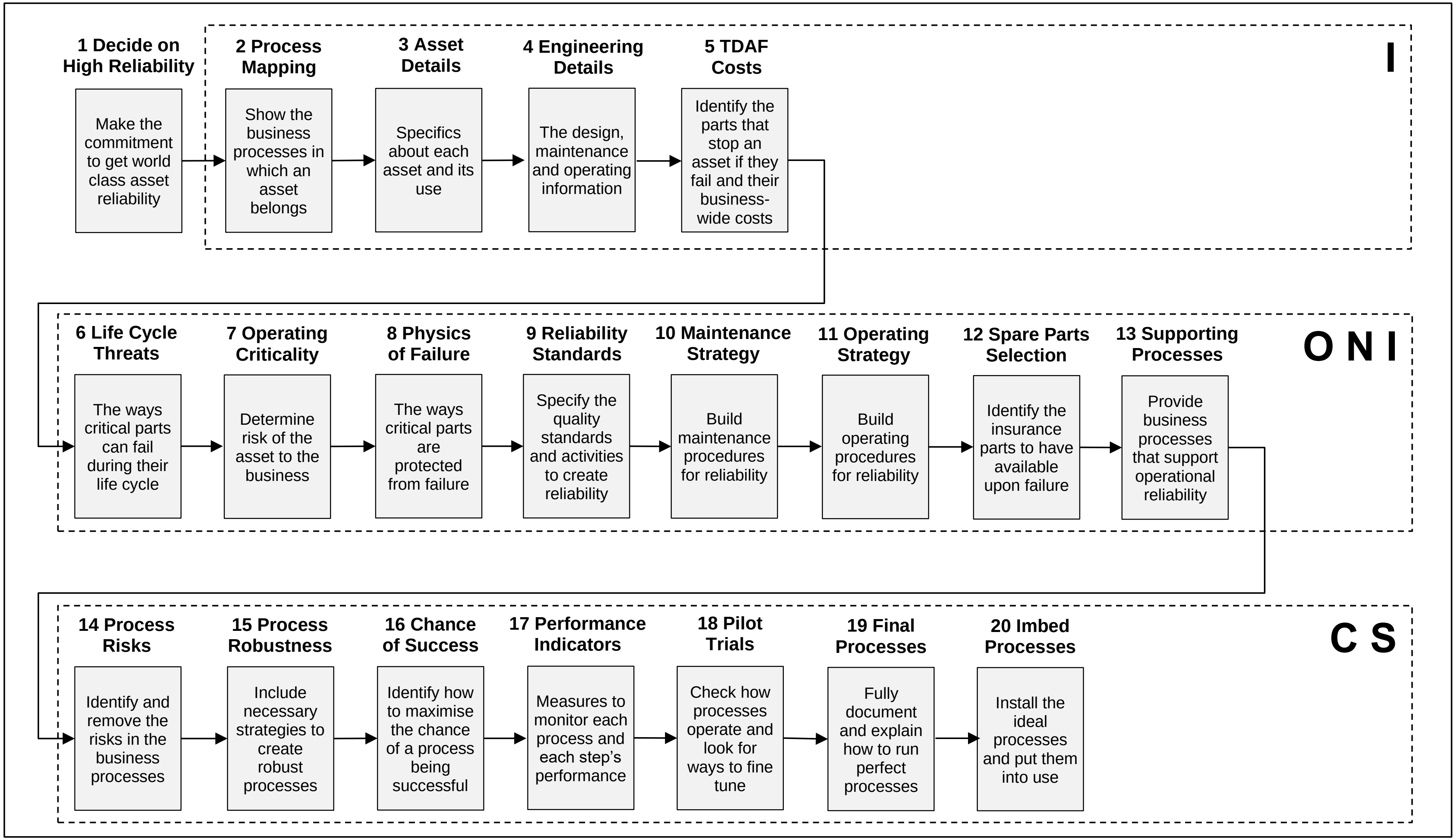


Figure 1.7—The Plant Wellness Way Methodology Six Step IONICS Process Map

The IONICS process steps are summarized below.

## 2.1. Decide You Want World Class Reliability

The Board and Senior Executives of an organization publically state their personal commitment to achieving world class reliability and allocate sufficient funds and resources to achieve it.

## 2.2. Flowchart from Business Process to Work Levels

Map the company as it is today from high level business operation right down to the procedures performed in the workplace.

## 2.3. Asset Lifetime Details

Describe each asset and understand its required duty and service life.

- Tag or Equipment Number
- Asset description
- Asset Criticality (highest rating from Asset Criticality Step)
- Asset location
- Asset purpose and required operational output(s)
- Installed new or second-hand? If second-hand, where was it used prior to this operation?
- Date installed in the operation
- Frequency of use during current service life
- Sub-assemblies (Children)
- Sub-assemblies Tag or Equipment Number (if used)

- Sub-assemblies description
- Histories of failures in this Asset
  - At the operating site (list failures by date in spreadsheet format)
  - Types of failures similar assets experience in the industry (list in a separate spreadsheet)

### 2.3.1. Asset Failure Frequency Distribution

- Create a failure run chart timeline for the asset over its entire service life to-date. Where possible identify the cause(s) of each failure event. You may need to look at the operating history in log books and shift logs, the maintenance history in the CMMS, and even conduct interviews with knowledgeable operations and maintenance personnel.
- Develop a failure event frequency distribution curve for the asset using the failure history timeline.
- Identify which failure types and/or causes occur too often.

## 2.4. Asset Engineering Design, Drawings, Manuals and Parts Lists

It is necessary that the construction, use and correct performance of an item of equipment is fully understood at the design engineering level. Gather together all the technical, maintenance and operational information about the asset, such as equipment manufacturer's information, manuals, drawings, etc.

Collect together these specific details about each asset:

- Service duty when in use

- Design data, e.g., max/min pressures(s), max/min flow(s), max/min temperature(s), max/min hours of operation, etc.
- Operating and Maintenance Manuals
- General Assembly Drawings
- Identify all sub-assemblies
- Identify all parts
- All parts materials-of-construction

## 2.5. Identify all Critical Parts and Their TDAF Cost

Identify the parts in an asset where their failure would stop a critical assembly operating—these are called critical parts. They are often the working parts, or the moving parts, in the asset. They can also be the structural components and/or the fastening components.

When critical parts fail there can be catastrophic consequences to the business. Determine the business-wide TDAF Costs of their failure to see how disastrous a breakdown is to the organization. Record this information in the Operating Criticality Analysis spreadsheet.

- Identify on the Bill of Materials list those parts that cause adverse production impacts if they fail.
- Estimate the TDAF Costs for each part's failure.

## 2.6. Critical Part Life Cycle Threats

Where a part can fail it becomes necessary to explore what events across its lifecycle could happen to become the root causes of the failure.

### 2.6.1. Answer the 8 Lifecycle Questions

In the Physics of Failure Factors Analysis spread sheet complete answers to the 8 Life Cycle Questions for each critical part.

You want to gain a solid understanding of the opportunities and situations when critical parts can fail and the circumstances that lead to a component's various ways of failing.

For each critical part identify if they can be failed from:

- Early Life Failures occurring from situations such as;
    - Manufacturing error
    - Human error during rebuild
    - Human error during installation
    - Human error during commissioning
- Random events, including:
    - extreme stress events
    - cumulative stress events
- Failures from asset usage, e.g. filters will block, brake pads will wear-out, etc.
    - Causes of a part's failure during operation
    - Hours of operation, number of times used, and/or production throughput between failure events
- Potential and extent of materials-of-construction fatigue

- Potential and extent of materials-of-construction wear-out (Aging)
- Degradation by damaging substances in its contacting environment

Do a Physics of Failure Factors Analysis to identify all failures that can happen to each critical part along with each of its cause mechanisms. In a POFFA you identify all the failure mechanisms from throughout a critical part's life cycle that cause risk of stress or structural harm.

- Use the Physics of Failure Factors guideword list to identify what events can fail microstructures from deformation, fatigue, degradation or damaging environments.
- Indicate all life cycle phases where each failure event cause can possibly happen.

The POFFA is done at this point to prove there truly are dangers and risks from throughout your business that can cause your plant and equipment to fail. If a company is to be world class reliable it must remove all dangers and risks to the reliability of its plant and equipment.

## 2.7. Asset Operating Criticality

Do an Operational Criticality Analysis to identify the business risk from a failure of each critical part in an asset. Determine Criticality 1 and Criticality 2 values for all critical parts. Use a separate spreadsheet for each production process used.

- Do risk analysis based on ISO 31000 Risk Management Guidelines or an equivalent
- Ensure the company's risk matrix is financially equivalent for its various consequences and properly applies $\log_{10}$-$\log_{10}$ math

- Expand the risk matrix into at least a 16x13 $\log_{10}$-$\log_{10}$ layout. It is preferable use $\log_{10}$-$\log_{10}$ scale for the axes if possible so movements in risk can be clearly seen.
- Calibrate the risk matrix and clarify the location of the Low risk level and other levels
- Make an estimate of the frequency the POFFA events can occur using the Likelihood scale of the risk matrix
- Develop an 'operating risk window' on the risk matrix from worst possible impact event to least impact event. Consider range of business impacts from its failure, including safety, financial, environmental, operational, etc.
    - Use TDAF Costs of each event in the criticality analysis
    - Downtime from each event (least to maximum duration)
    - Include 'acts of God' where such are possible, e.g. lightening, floods, earthquake, tornado, etc.
- Take into consideration the knock-on impacts of an asset's failure
    - What else stops when the asset fails?
    - Would subsequent harm also occur to personnel, environment, next door sites, etc.?
    - What redundancy exists for the asset?
    - The time taken to supply failed parts once an order is placed

### 2.7.1. Sub-Assembly Criticality

Due to the size and complexity of an asset it may be necessary to separately investigate its sub-assemblies.

- Repeat the above costing for each of the sub-assemblies (Children) where a failure will stop an asset's operation.

## 2.8. Physics of Failure Reliability Analysis

Complete a Physics of Failure Reliably Analysis for those parts that carry unacceptable operating risk from failure. The aim is to prevent all risk and defect creation events from occurring throughout a component's lifetime. Select effective risk controls and mitigations for each failure mechanism using the Physics of Failure Reliability Strategy selection spreadsheet.

- Complete the asset details in the PoF Reliability Strategy spreadsheet
- Transfer all POFFA critical parts and their cause mechanisms into the spreadsheet
- Determine suitable life cycle strategies to eliminate or prevent each mechanism arising
- Indicate all the life cycle phases in which the risk mitigations are to be used

## 2.9. Specify Reliability Standards by Equipment Part

Identifying what can be done to achieve maximum reliability for a part's whole operating life requires defining precision zones of outstanding operation for each critical component using the Precision Maintenance criteria noted in Table 1. To tailor probability in your favour set 3T (Target – Tolerance – Test) quality values for each criterion listed. Extend the list to include all engineering, maintenance and operating criteria needed to address the POFFA mechanisms. Though the list in the table applies to mechanical equipment, the intention of each requirement can be extrapolated to address other types of physical assets and their components, including structural, civil, electrical and electronic items.

You want a critical part to always remain within its reliability precision zones by selecting the appropriate quality standards for engineering, maintenance and operating activities and practices. The standards let you monitor actual behaviour during equipment use to prove and ensure a component suffers the least stress possible in every situation across its lifetime.

- A Target Value (ideally this is world class performance, or else it is a magnitude better performance than 'average' performance)
- A maximum to minimum Tolerance Range (the minimum is that value specified by the original equipment manufacturer in their manuals).

In the case of dimensions, instead of specifying each part's specific tolerance values you can use International Tolerance Grade Numbering, as this automatically allows for changes in component sizes and distances.

| Item | Description | 3T Quality Criteria |
|---|---|---|
| 1 | Accurate Fits and Tolerance at Operating Temperature | Target:<br>Tolerance:<br>Test: |
| 2 | Impeccably Clean, Contaminant-Free Lubricant Life-long | Target:<br>Tolerance:<br>Test: |
| 3 | Distortion-Free Equipment for its Entire Lifetime | Target:<br>Tolerance:<br>Test: |
| 4 | Shafts, Couplings and Bearings Running True to Centre | Target:<br>Tolerance:<br>Test: |
| 5 | Forces and Loads into Rigid Mounts and Supports | Target:<br>Tolerance:<br>Test: |
| 6 | Collinear Alignment of Shafts at Operating Temperature | Target:<br>Tolerance:<br>Test: |
| 7 | High Quality Balancing of Rotating Parts | Target:<br>Tolerance:<br>Test: |
| 8 | Low Total Machine Vibration | Target:<br>Tolerance:<br>Test: |
| 9 | Correct Torques and Tensions in all Components | Target:<br>Tolerance:<br>Test: |
| 10 | Correct Tools in the Condition to do the Task Precisely | Target:<br>Tolerance:<br>Test: |
| 11 | Only In-specification Parts | Target:<br>Tolerance:<br>Test: |

Table 1—Set Necessary Health Conditions for Mechanical Parts

The activities needed to achieve and sustain the quality standards that maximize reliability of a critical part become the operating, maintenance and reliability strategies adopted for the component during its lifetime. The sum of an equipment's parts strategies become the asset's life cycle management strategy. All strategies will be detailed in the asset's associated engineering, operating, maintenance, and reliability procedures and relevant documents.

### 2.9.1. Reliability Growth Cause Analysis

This technique is a detailed reliability strategy selection analysis and cost benefit justification for the tasks used to make a part survive to maximum service life.

## 2.10. Maintenance and Installation Parts Deformation Management

The requirements are to have all equipment parts in their least stress, full-health state when in operation and to sustain those conditions throughout the equipment's service life. Identify the life cycle microstructure risks for each critical part using the Physics of Failure Reliability Strategy spread sheet. Where statutory Laws and Regulations apply to an asset, such as with cranes, pressure vessels, lifts, etc., include the necessary maintenance requirements into an additional column in the spread sheet.

- For each critical part identify:
  - Necessary health conditions for the part, e.g. precision tolerance range, temperature range, moisture/humidity range, etc. The information identified in response to the list of 3T quality parameters required by Table 1 will satisfy this requirement
  - Necessary health conditions of neighbouring parts in contact, e.g. surface finish, temperature range, etc.

  - Likelihood that the health conditions will be achieved during installation
  - Likelihood that the health conditions will be sustained during operation
  - What installation and maintenance opportunities can arise to cause deformation, e.g. installation during construction, overhaul during service life, major failure requiring rebuild, etc.?
  - How frequent will the identified installation and maintenance opportunities for deformation arise?
- Check the Physics of Failure Guidewords to confirm all situations are identified and covered by a suitable and effective strategy for the part, and also for its neighbours.

#### 2.10.1. Develop Maintenance Procedures

For each critical part put the required controls needed for every cause of deformation into a written ACE 3T maintenance procedure to create a component with low stress in a healthy environment.

In time a library of procedures for component health will accumulate to be used repeatedly in future for those assets where critical parts suffer the same situations and threats of failure.

#### 2.10.2. Identify Work-Around on Failure

Where there are means to minimize the production impact of an asset's failure, then list and explain the option(s), e.g. redundancy; hire mobile equipment; transfer production to another line; etc.

### 2.11. Operating Strategy Parts Degradation Management

The requirement is to have all equipment critical parts in their least stress condition when under operation and sustain those conditions throughout the equipment's service life. Develop answers for the parts in the Physics of Failure Reliability Strategy spread sheet.

- For each critical part address:
  - Necessary operating conditions for the part, e.g. operating pressure range, operating temperature range, operating moisture/humidity range, etc.
  - Likelihood that the operating conditions will always be achieved
  - Likelihood that the operating conditions will be sustained during service life
  - What operating opportunities can arise to cause degradation, e.g. change-overs, process disruptions, poor raw material, contamination, etc.?
  - How frequent will the identified operating opportunities for degradation arise?

- Check the Physics of Failure Guidewords to confirm all situations are identified and covered by a suitable and effective strategy.

#### 2.11.1. Develop Operating Procedures

For each critical part put the required controls needed for each cause of degradation into a written ACE 3T operating procedure to create a component with low stress in a healthy environment.

#### 2.11.2. Identify Work-Around on Failure

Where there are means to minimize the production impact of an asset's failure, then list and explain the options(s), e.g. redundancy; hire mobile equipment; transfer production to another line; etc.

## 2.12. Spares Selection by Part

The spare parts required to be speedily available are chosen based on the operational risk from a part's failure. Develop the answers for each critical part in the Physics of Failure Reliability Strategy spread sheet.

- Determine the TDAF Cost consequence of a critical part's failure, allowing for what work-around is available to the client
- Frequency of a critical part's failure:
  - in the operation
  - in the industry
- Time for Supplier to deliver replacement part when ordered
- The resulting risk reduction if a part is available in a timely manner.

## 2.13. Supporting Business Processes

Use the 'Stress to Process' model to identify who must be involved throughout the organization to insure the integrity and security of the asset and its critical parts for both degradation management and deformation management during:

1) Design selection
2) Manufacturing
3) Procurement and delivery
4) Initial installation
5) Throughout its service life
6) Decommissioning and disposal

Set the responsibilities to do all Physics of Failure Reliability Strategy actions. This requires identifying who will do the work of delivering the reliability strategy. For each critical part's reliability strategy specify the:

- Skill set and minimum competence required
- Role(s) or Function(s) who will do the work
- Organisational Department owning the work

Identify all those documents that will contain each of the lifecycle strategies, actions and monitoring, e.g. procedure, work instruction, duty statement, etc. so ownership of responsibilities are clearly allocated. The same reliability-creation information can be required to reside in more than one document.

### 2.13.1. Design and Operating Costs Totally Optimized Risk (DOCTOR)

The DOCTOR business risk assessment it to be immediately introduced into all capital projects and plant change projects.

## 2.14. Risk Analysis of Supporting Business Processes

Check to see what risk situations, scenarios and events can arise in those business processes impacting the life cycle to cause the failure of any critical parts in an asset.

Put the process steps across the top of a spread sheet and for each step do a risk analysis focused on how a step can cause plant and equipment parts to fail. In the analysis address the risks in each business process and its individual steps affecting:

- A complete asset
- Sub-assemblies
- Parts and components
- Work procedures

## 2.15. Build Process Robustness

Once potential problems are identified 3-Factor Risk Analysis strategies are selected to substantially reduce the risks and mapped onto a risk matrix to confirm sure risk reduction will occur. All means to make processes anti-fragile and robust are developed and incorporated into business process and procedures.

Consider applying the following techniques:

- Consequence reduction strategies
- Opportunity reduction strategies
- Uncertainty reduction strategies
- Improving component robustness and reliability
- Parallel tasks (application of the Carpenter's Creed, 'measure twice, cut once')
- Convert to 3T (Target-Tolerance-Test) error-proof activities
- Include mistake-proof techniques in the process design

## 2.16. Chance of Success Analysis for Processes

Once a process is designed you can simulate and test how well it will work. A business process has risks of failure in each process step. Identify what can prevent a process step being completed correctly. Possible problems that arise in each process step are recorded and a value of the chance of a problem's occurrence is determined from historical data. Processes that have an unacceptably high chance of not working well are weak processes and are redesigned to be much more effective.

Develop a flow chart of the process showing all steps across the top of a spread sheet. For the process:

- Explain and define the purpose of each step
  - Describe the procedure to do the step
  - Specify the correct step inputs using 3T (Target-Tolerance-Test) format
  - Specify the correct step output using 3T (Target-Tolerance-Test) format
- Identify problems and weaknesses in each process step through the use of risk analysis
- Make probability estimates of each existing process step's low and high chance of success
- Calculate the whole current process low and high chance of success
- Propose how to resolve unacceptably weak process steps
  - Introduce 3T (Target-Tolerance-Test) controls
  - Introduce redundancies
  - Introduce effective technology
  - Redesign the step with a more effective procedure

- Make low and high probability estimates of each redesigned process step's chance of success
- Calculate the redesigned process low and high chance of success
- Continue developing solutions for weak processes until the low chance of success for the whole process is adequately high

## 2.17. Performance Indicators

The effectiveness of a process is seen in its results. Develop measures to monitor your processes and workplace activities. Imbed the data collection and report generation into relevant procedures.

- Establish process step Performance Indicators for self-monitoring by the step 'owner'
  - Monitor inputs
  - Monitor outputs
  - Establish frequency distribution curves of step monitoring PI's
- Establish process outcome KPI's for regular Senior Management monitoring
- Establish frequency distribution curves of Senior Management KPI's
- Monitor performance with a useful mix of:
  - Leading indicators
  - Lagging indicators
  - Process distribution curves
- Cascade measures across departments and roles if necessary to understand the process behaviour

### 2.17.1. Continuous Improvement

To keep moving a company forward keep moving the required performance ever higher toward its pinnacle of excellence by making the ACE 3T standards ever more demanding.

## 2.18. Pilot Test Trials

A new process is designed to what seems a suitable degree of outcome certainty. Before changing an entire business to the new process it needs to be tested in the workplace to be sure it is effective. A Change-to-Win project can be used to involve the Users of the new process and get their input and buy-in. The learning from the trial is put back into the process design to make changes and refinements that improve its chance of success when implemented in the company.

## 2.19. Document the Final Process Designs

Specify and define the complete process and all its procedures in total detail to ensure process control and capability.

For each process:

- Flowchart each level, from top overview down to the shopfloor, in the detail needed to get the desired success rate.
- Establish procedures, including detailed instructions when risks in process steps justify the need to be meticulous.
- Incorporate 3T (Target-Tolerance-Test) quality assurance
- Identify each process step 'owner' who has ultimate responsibility to do the step correctly

- Identify each process step 'buddy' where persons are put in parallel for better process reliability

## 2.20. Imbed the Final Processes

Prior to putting the final process design into use all persons impacted by the new process require appropriate levels of training and practice. The people working in a new process need to be competent to do their changed roles before the process is implemented. To become proficient requires both the education and understanding of what is to be done, as well as the practical skills to ably to the role.

The final action is to run the process in its entirety and monitor if its individual steps are delivering the required performance results. Where problems arise look at the step distributions to identify the causes of excessive variation and fix the process design.

## Answers to Your Questions

You are welcome to contact us with any questions you wish to ask about the contents of this report.

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