Conscious Asset Reliability Program

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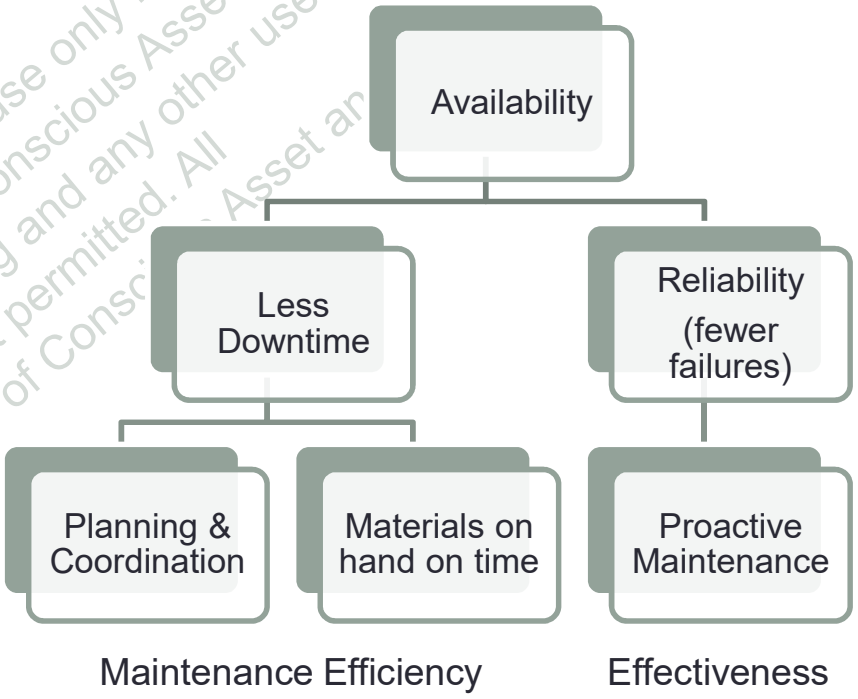
Concepts

- Reliability – how often is it down?
- Availability – how much is it up?
- Production wants both availability and reliability for stability and less variability



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Benefits

- Production
- Costs
- Quality
- Safety
- Environment
- Security

- It is cheaper, safer and less harmful to run well and produce good quality output

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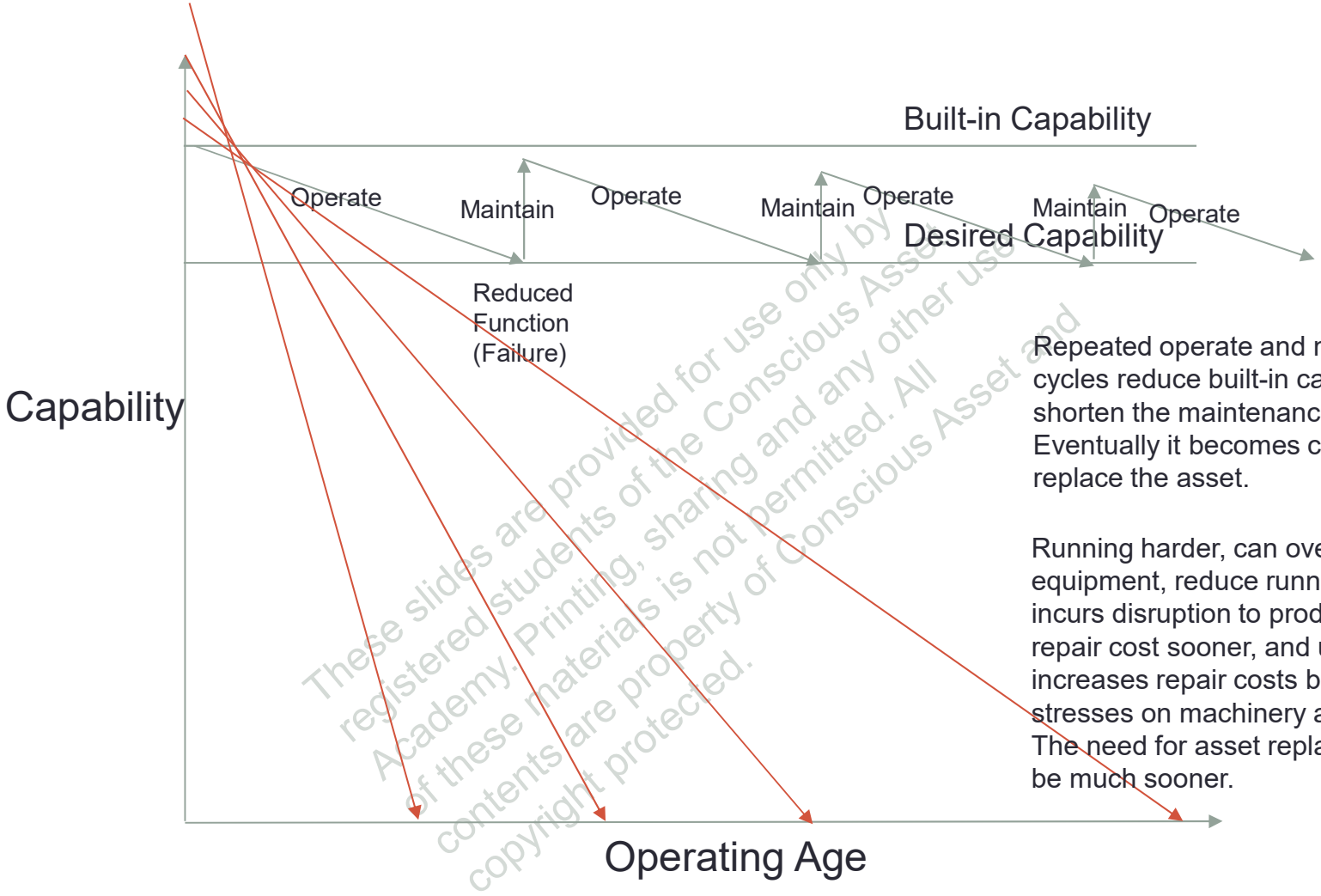
Run within limits vs. Running hard



Repeated operate and maintain cycles reduce built-in capability and shorten the maintenance cycle. Eventually it becomes cheaper to replace the asset.

Running harder, can overload equipment, reduce running "life," incurs disruption to production and repair cost sooner, and usually increases repair costs because stresses on machinery are higher. The need for asset replacement will be much sooner.

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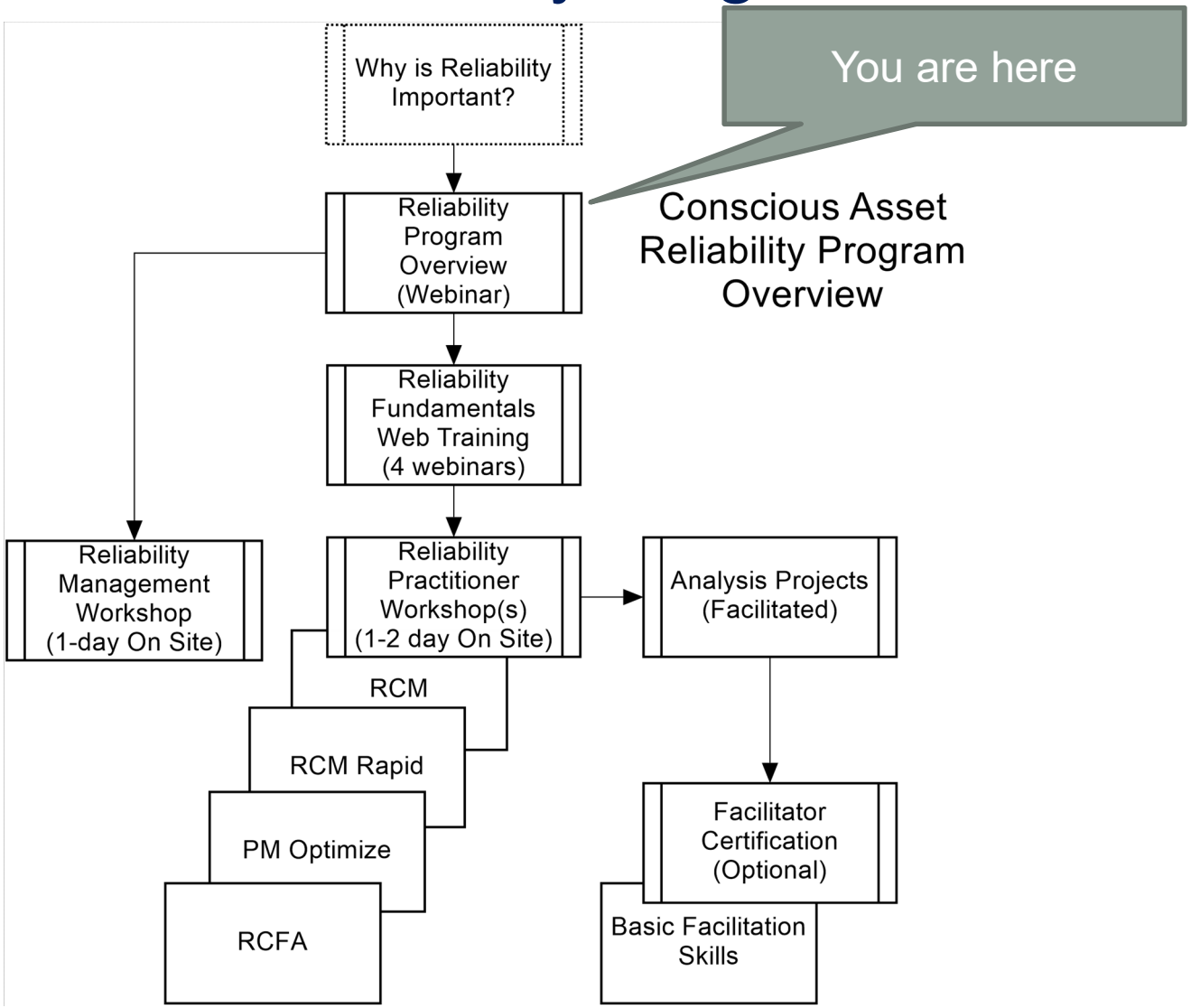
Reliability isn't just a maintenance job

- Design must be capable
  - Capability must be built in
  - Reliable design needed
- Maintenance must be enabled to sustain capacity
  - Appropriate and timely proactive maintenance
  - Efficient restoration when needed
- Production / operations must operate within the machine / system capabilities
  - Overloading (especially if sustained) defeats the purpose

Our Focus

Conscious Asset Reliability Program



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Topics

- ✓Concepts
- ✓Program elements
- Asset Register and Criticality
- Reliability program elements
  - Reliability Centered Maintenance (RCM)
  - Rapid RCM
  - PM Optimization
  - Rapid proactive maintenance deployment
  - Root Cause Failure Analysis (RCFA)
  - Optimization and Evidence Based Asset Management (EBAM)
- Ensuring success
  - Leadership and the role of management

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Asset Register

- Listing of all physical assets under management
- Fixed Plant: list is often “indentured” to show hierarchical arrangement of:
  - Systems,
    - Sub-systems,
      - Equipment
        - Assemblies
- Fleet: list of asset “types” blended with indentured hierarchy of vehicle systems
- Financial world has its needs to track assets
  - Largely related to reporting of asset value and depreciation
  - No real need for depth beyond asset “classes”
- Asset Management world needs depth
  - Tracking of asset performance, history, work, configuration, related parts, etc.

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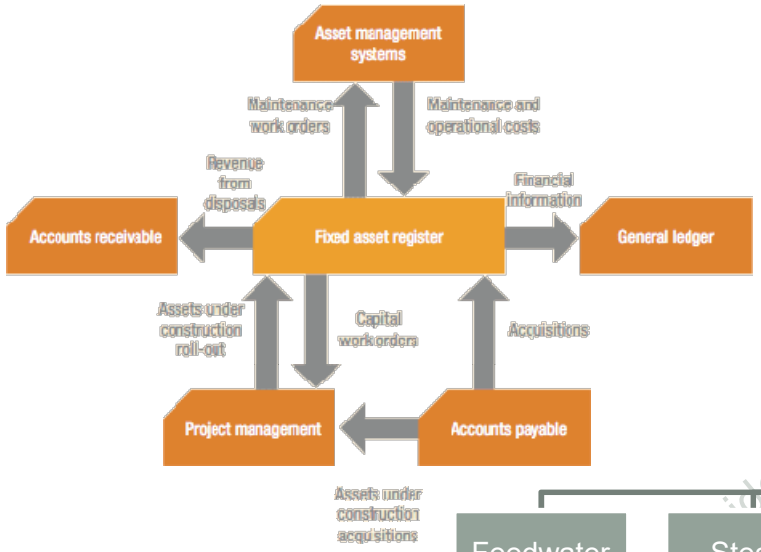
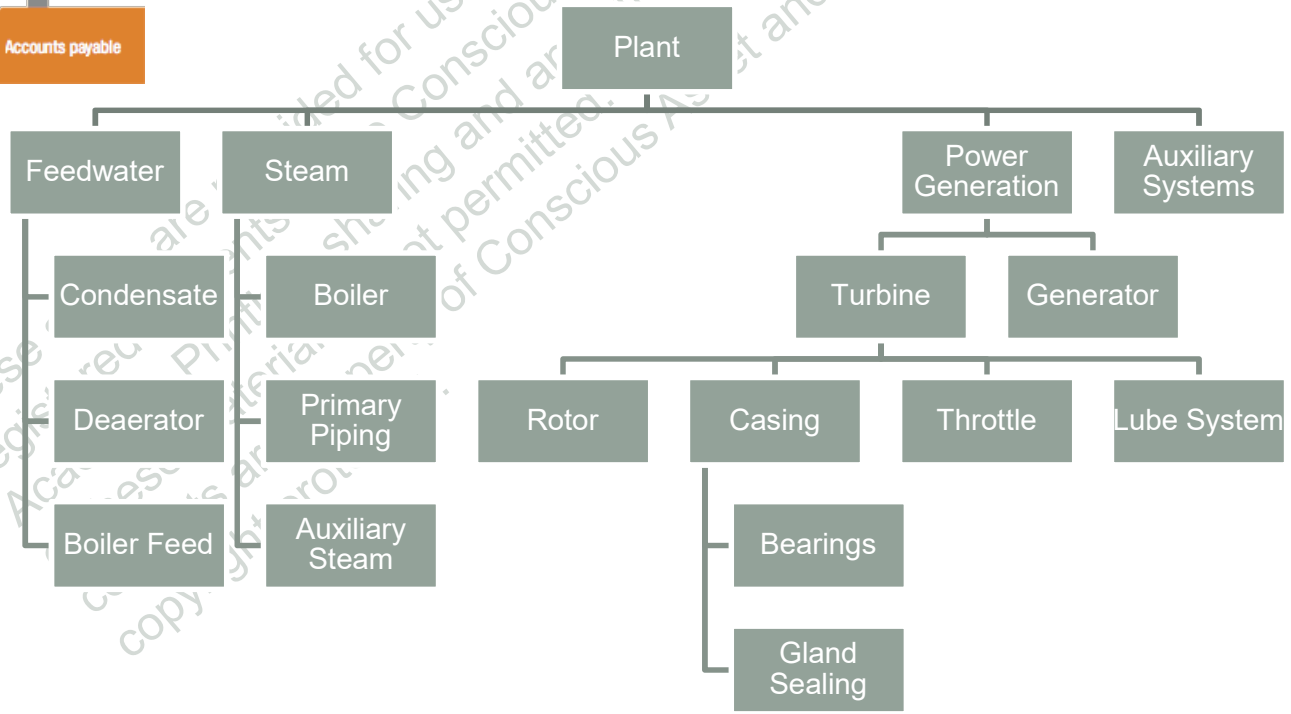
Financial and Asset Management lists



Not uncommon for companies to have multiple asset hierarchies – one for financial purposes and at least one for maintenance / engineering



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Criticality

- Criticality and Priority are different
  - Priority – how soon do you need this work to be done?
    - Important in “work management / planning and scheduling”
  - Criticality – how important is this asset to the business?
    - Important in managing risks to your business

- What makes an asset “critical”?
  - Risk to the business
  - Risk considers consequences with probability of occurrence
    - Consequences (severity)
      - A failed asset can impact:
        - Production levels / revenue generation,
        - Operating / maintenance costs,
        - Quality of output,
        - Safety,
        - Environment,
        - Public image,
        - Security.
    - Probability (likelihood) of the failure / consequence
  - Critical assets potentially have high impact and high probability of that impact

Criticality blends severity with likelihood

Frequency	Minor 1	Low 2	Marginal 3	Significant 4	Catastrophic 5
Frequent 5					
Likely 4					
Occasional 3					
Infrequent 2					
Almost never 1					

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Using Criticality

- Determine what to work on first
  - High criticality
  - High business impact (e.g.: cost, downtime, consumes too much labor…)
- Determine what methods to use
  - RCM (most complex, labor intensive, thorough)
    - Red or high criticality
  - S-RCM or PMO (less complex, work, less thorough)
    - Yellow or medium criticality
  - Rapid PM deployment or "do nothing"
    - Green or low criticality
- Resources "stretched"?
  - Start with rapid PM deployment across the board and focus on planning & scheduling efforts
  - Apply RCM for high criticality
  - Then use S-RCM for medium criticality

Reliability Centered Maintenance (RCM)

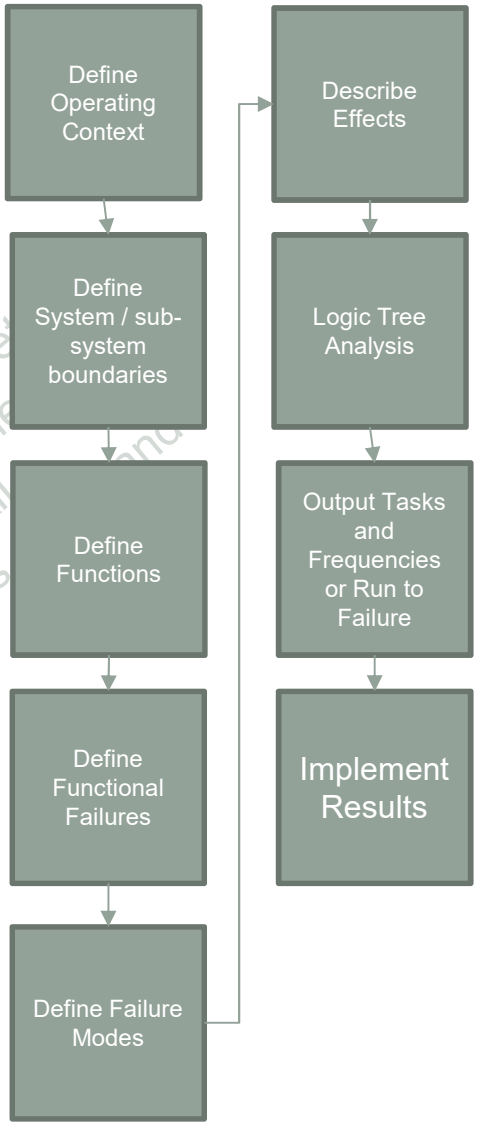
- SAE JA-1011
  - “RCM is a specific process used to identify the policies which must be implemented to manage the failure modes which could cause the functional failure of any physical asset in a given operating context.”

- Pros
  - Thorough and comprehensive analysis produces excellent and well documented decisions
  - Proven success in a wide range of industries and circumstances
  - Can be applied at design and operational phases in “life cycle”
- Cons
  - Requires extensive training and dedicated implementation
  - Can be labor intensive and time consuming (team based approach)
- Recommended for highly critical assets

RCM's approach

- Define operating context (this can change for similar assets in different environments)
- Define functions, functional failures, failure modes, describe effects and for each failure mode use a decision logic to determine suitable proactive or other default maintenance activities
- Define what is done, by whom and how often

This sounds easy, but without proper training, mentoring and practice it is far more difficult than it appears.



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Rapid RCM

- RCM can be labor intensive, time consuming and expensive
- Difficult to justify for assets that are not highly critical
- Yet medium and low critical assets deserve attention

- Rapid RCM (RRCM) reduces the effort, time and cost so RCM-inspired thinking can be applied broadly
  - Less complex but not as thorough as RCM – fewer steps
  - Less effort – can use teams or individuals
  - Less time needed to document the process and decisions
  - Increased risk that something will be "missed"
    - Not suitable for highly critical assets
  - Increased reliance on fewer participants places greater emphasis on their need for system / operational knowledge
  - Potential to analyze more assets in a shorter time

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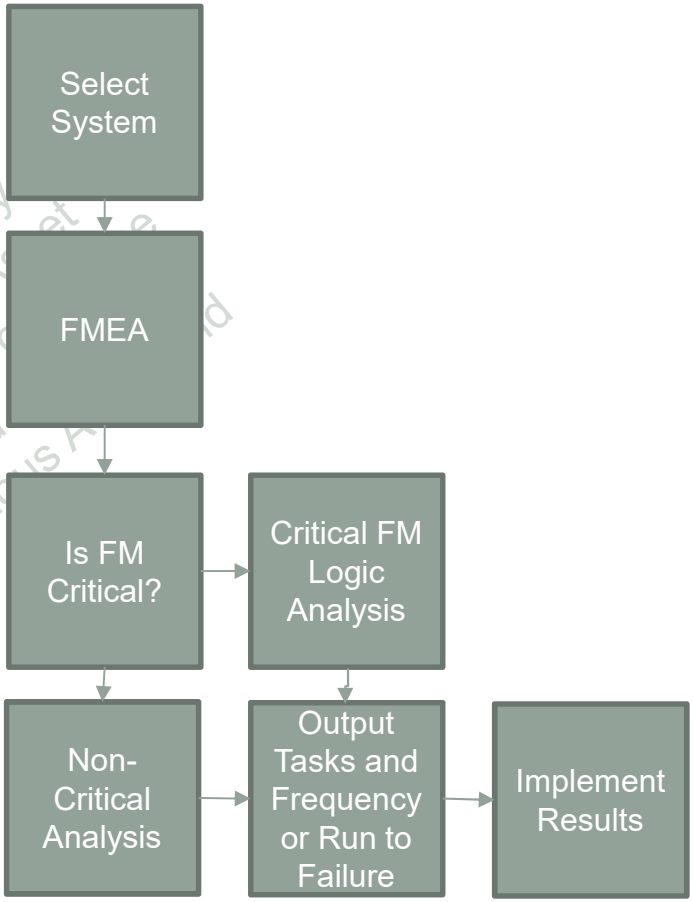
Rapid RCM approach

- Similar to RCM
- Functions classified as important or non-important
- Important functions analyzed thoroughly (FMEA)
- Non-important functions go through a non-critical analysis



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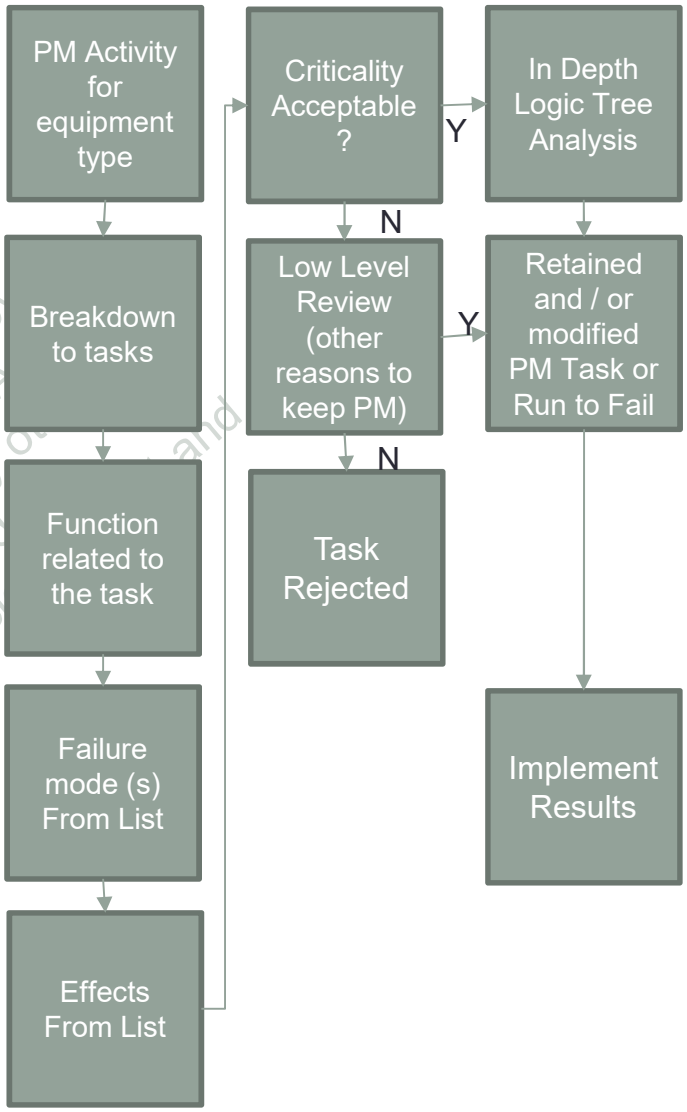
PM Optimization

- Many organizations already have a Proactive Maintenance Program in place (Preventive, Predictive…)
  - Often there is room to improve
  - Existing “PMs” can be: refined, replaced, removed, frequency adjusted or added
  - Low Criticality may not warrant RCM effort and rigor
- May be used as precursor to RCM in an effort to get improved performance, freeing up resources for RCM
  - NOT a replacement for RCM for critical assets
- May be used to refine RCM program results
- Useful to review PM program before migrating to new CMMS

PM Optimization Approach

- Start with existing "PMs", lists of standard "failure modes" and "standard effects"
- Failure modes will vary by equipment type
- Effects reflect potential impacts on the business (context)



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Rapid PM Deployment

- Proactive maintenance involves use of Preventive and Predictive methods / tools:
  - E.g.: vibration analysis, thermographic imaging, oil analysis, etc.
- Each of those is intended for many similar circumstances
  - E.g.: vibration analysis can be used for any application involving dynamic equipment; thermography can be used wherever there is a “heat signature”
- What are you doing now?
  - Preventive Maintenance – intrusive overhaul, restoration or replacements
  - Predictive Maintenance – what condition monitoring do you have / or can get
  - Detective Maintenance – are you testing back up and safety systems?
  - Are you getting the reliability you want?
    - If not, then doing more or refining how you do it may help.
    - Rapid PM Deployment is based on general rules of application of various techniques / technologies
- Alternative
  - Use PM templates by equipment type in similar operating contexts

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Root Cause Failure Analysis

- Reliability methods do not solve all problems
  - You may still have failures that were unexpected or deemed to be excessive or problematic
  - These may be acute failures, or minor but chronic problems
- There may be a need to resolve some major problems before you can apply RCM or other proactive analytical approaches
- RCFA begins with the failure you want to avoid
  - It is precise in targeting specific failures (unlike the proactive methods that are much broader in application)
  - It can fill in the gaps where other methods have missed something
- Approach is “reactive”
  - Work back from the failure event to a cause (condition or other event) that can be controlled and changed / eliminated
    - Various techniques: Kepner-Tregoe™, 5-Whys, PROACT™ RCA, Apollo …

Optimization and EBAM

- No reliability program is ever “perfect”
  - Always room for improvement
- Some failures defy solution using the previous methods
- Optimization covers an array of possible problems to be solved.
  - It entails use of statistical evidence and analysis of that data to determine a suitable course of action.
    - There is a need to understand failure statistics and reliability mathematics, modelling techniques and analysis methods
    - Organizations with dedicated maintenance and / or reliability engineers will benefit from these methods

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Optimization and EBAM

- Preventive maintenance and optimal spares stocking policies
  - Analysis of component failure data
  - Dealing with censored data
  - Component replacement
  - Spare parts provisioning
- Predictive maintenance
  - Inspections
  - Health Monitoring
- Effective use of maintenance resources, scheduling and planning
  - Organizational structure, crew size, workshop resources
  - Maintenance Management Information systems
  - Maintenance Planning and Scheduling (case studies)
- Life Cycle Costing Management
  - Economic life
  - Repair vs. replacement
  - Future costs of a fleet
  - LCC with limited (or no) data
  - Case studies

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Ensuring Success

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Technical

- Develop capabilities
  - Management / leadership workshop
    - Reliability is not just a technical discipline
  - Practitioner development
    - What everyone should know
    - Program workshops (RCM, RRCM, PMO, RCFA)
  - Reliability leaders
    - Facilitation skills (general)
    - Mentoring On The Job (co-facilitation)
    - Certification
  - Reliability specialists (engineers)
    - Advanced reliability technology / mathematics / tools
    - Certification (University Level Continuing Education)

Change Management

- Put the methods to use
  - Planning for success
    - Understand past failures and lessons learned
    - Eliminate barriers
    - Buy in
  - Asset register / hierarchy - verification
  - Criticality analysis
    - Determine cut-off points
    - Determine methods for each criticality range
  - Pilot projects (by method)
    - Some of these are part of Reliability Leader certification
  - Roll out of reliability methods by system

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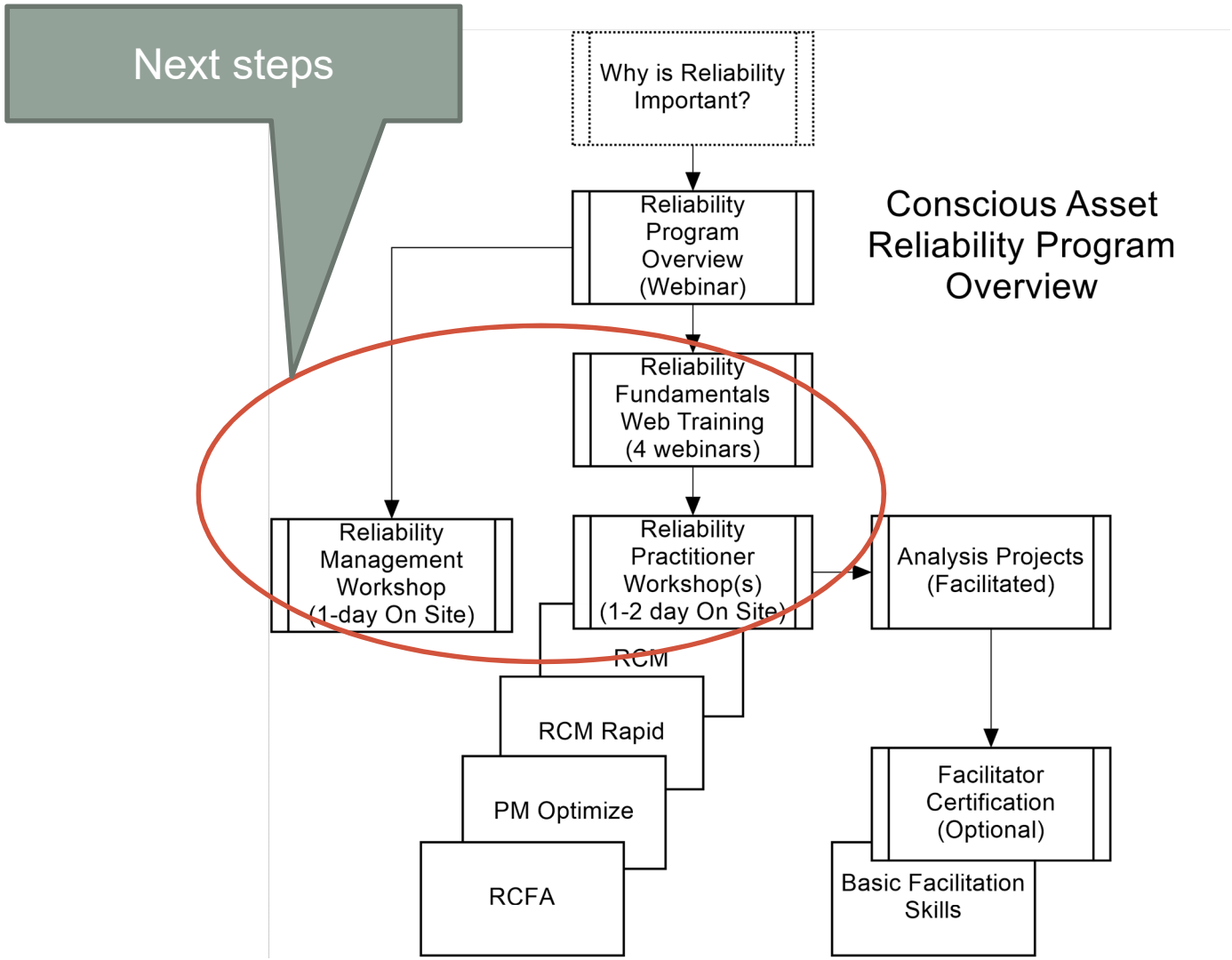
Governance

- Reliability monitoring program
  - Making sure you get the results you expect
- Continuous improvement cycle
  - Using enhancement methods
- Sustaining the effort (management role)
  - Governance
  - Management of change
  - Asset information management

Conscious Asset Reliability Program



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Next steps

- Reliability Management Workshop for Managers
  - Setting the stage for successful implementation
    - 1 day on-site workshop
- Reliability Fundamentals Workshop for practitioners and leaders
  - Setting the stage for technical competence
    - Online
      - 4 x 1.5 hour sessions with quiz
    - Or 1 day onsite
  - Pre-requisite for:
    - Practitioner Training (to participate in reliability improvements) and / or
    - Reliability Projects (co-facilitation / certification)

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It’s time to optimize