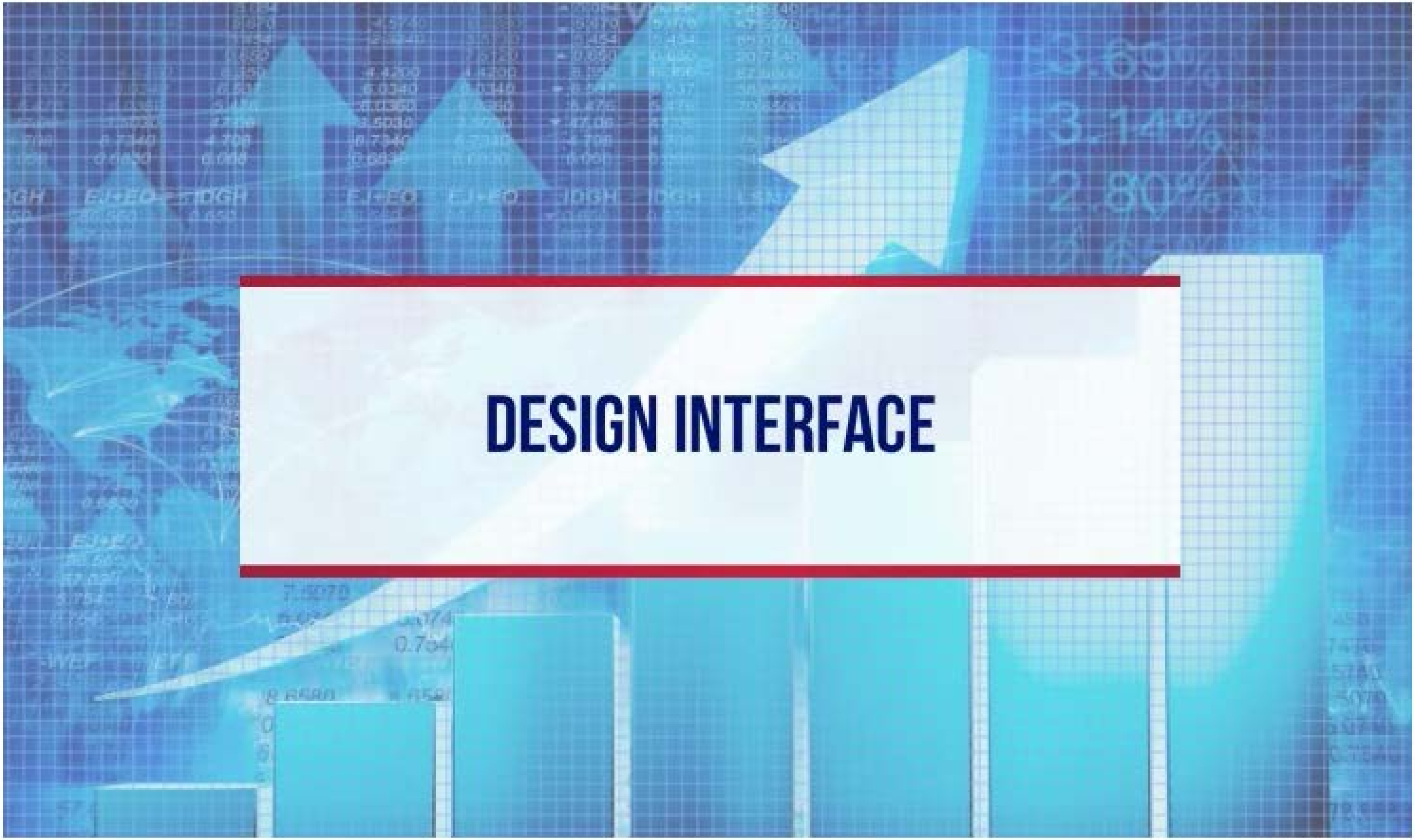
Welcome



Learning Objectives

Upon completion of this lesson, you will be able to:

- Describe basic Reliability and Maintainability (R&M) terminology and relationships
- Describe how R&M affects Operating and Support cost estimates
- Describe basic R&M data sources

Closed Captioning

Upon completion of this lesson, you will be able to:

- Describe basic Reliability and Maintainability or R&M terminology and relationships.
- Describe how R&M affects Operating and Support cost estimates.
- Describe basic R&M data sources.

Why Is This Important?

Design Interface certainly covers more territory than Reliability, Availability, and Maintainability. But in the Operating and Support cost arena, the two areas of Reliability and Maintainability are major factors in determining these costs over the life cycle.

The following statements support these factors:

- Reliability is the single biggest influence on Operating and Support costs across the life cycle.
- Maintainability has a major impact on equipment downtime and on the manpower and personnel required to keep a system operational.
- Both Reliability and Maintainability are "design" characteristics
- While a program's logisticians don't design the system, they must be prepared to evaluate system design for its impact on supportability and life cycle cost.



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Long Description

Helicopter approaching aircraft carrier, military personnel working on aircraft, group of military personnel in planning session.

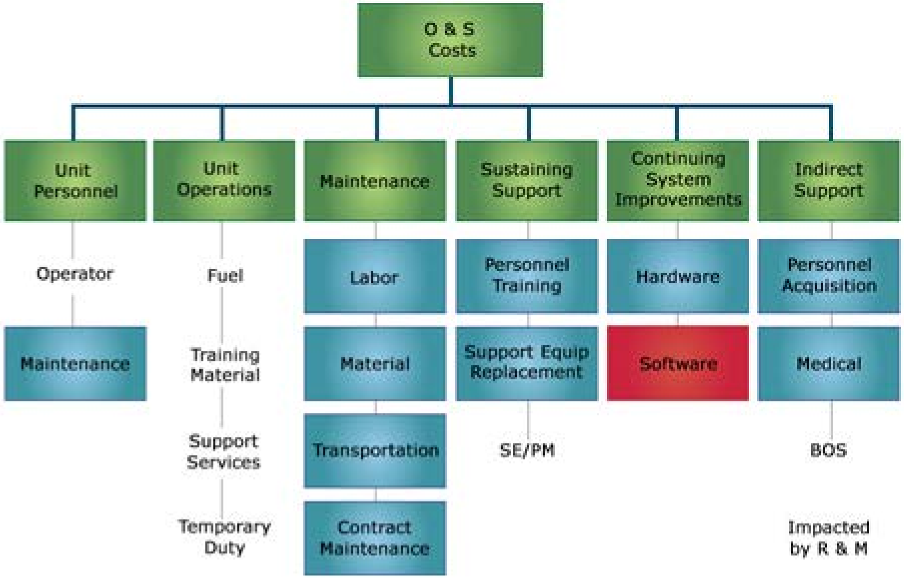
What is "Design Interface"?

Despite having been one of the traditional Integrated Logistics Support elements for a number of years, Design Interface is still often misinterpreted and misunderstood, even among logistics professionals. Too often, it is confused with interoperability. Phrased another way, it is the impact that the design of the system, most often expressed in terms of reliability and maintainability, has on support planning and the resources required to implement that planning. Design Interface can be defined as:

- The relationship of logistics-related design parameters, such as reliability and maintainability, to readiness and support resource requirements.
- It is NOT "interoperability"
- It's "design interface," not "interface design"

RAM Impacts On O&S Costs

This chart depicts an O&S cost taxonomy and shows how pervasive R&M factors are with respect to O&S costing. The shaded boxes are those in which the cost element can be expected to significantly change with changes in reliability or maintainability. In most cases, improvements in R&M will decrease costs both in material and in maintenance manpower. However, this is not universally true because in many cases R&M improvements come about only through increases in acquisition costs. For example, a higher reliability may be achievable only with an increase in costs for procuring better parts. This should result in fewer failures but the higher replacement cost may reduce or even negate the advantage of fewer repair demands. **Select image to enlarge.**



Acquisition, O&S, and R&M

It would make life much simpler if a dollar invested in reliability and maintainability during the acquisition cycle resulted uniformly in a dollar-plus reduction in O&S costs over the life of the system. But that, unfortunately, is not reality. While, generally speaking, improved reliability and maintainability will decrease O&S costs, the cost to achieve these improvements may offset any potential savings.

Acquisition, O&S, and R&M, Cont.

Individual program characteristics drive individual program answers to questions posed. In the trade studies undertaken to answer these questions, the PSM must be actively engaged to ensure that assumptions, ground rules, and techniques used accurately reflect reality as best he or she knows it. This is a recurring theme throughout this course. Improved reliability and maintainability will decrease O&S costs; the cost to achieve these improvements may offset any potential savings. The most frequent question posed is, "How does the program decide how much is affordable?"

R&M initially costs money but saves more over the long haul.

Money costs come through:

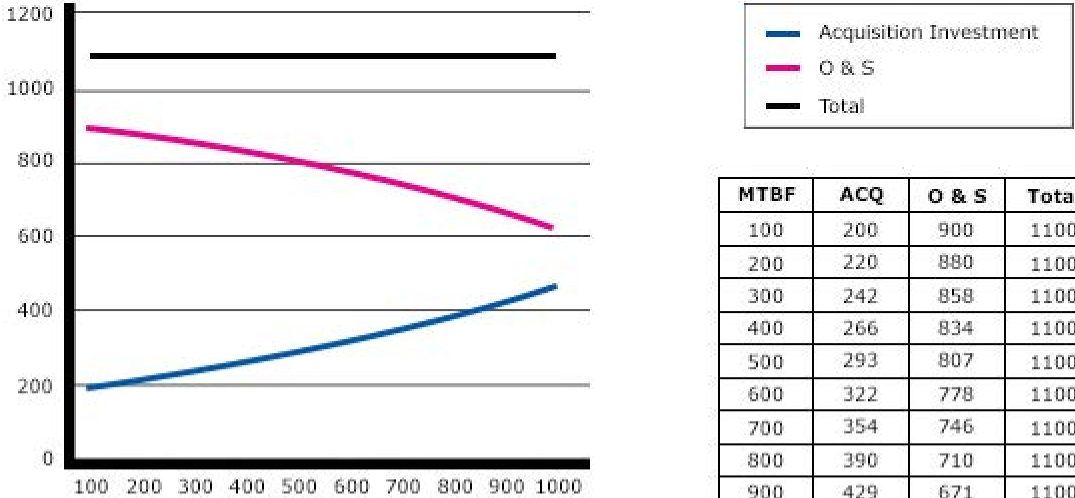
- Redundancy
- Higher grade components
- Diagnostic equipment
- Design for better component access

Savings come through:

- Less maintenance (labor, parts, support equipment)

Life Cycle Cost Trade-Offs: Case 1

Let's look at some hypothetical examples. In the event that there is a direct tradeoff between investment dollars and O&S dollars, the total cost remains unchanged. If this is the ultimate result of a decision, it is highly unlikely that a decision will be made to spend the money to get the improved R&M performance. There is no compelling reason to make the investment. **Select image to enlarge.**



Case 1: Every dollar of investment saves a dollar of O&S.

MTBF	ACQ	O & S	Total
100	200	900	1100
200	220	880	1100
300	242	858	1100
400	266	834	1100
500	293	807	1100
600	322	778	1100
700	354	746	1100
800	390	710	1100
900	429	671	1100
1000	472	628	1100

MTBF = Mean Time Between Failure (in hours)
ACQ = Acquisition Investment Cost
O & S = Operating and Support Cost

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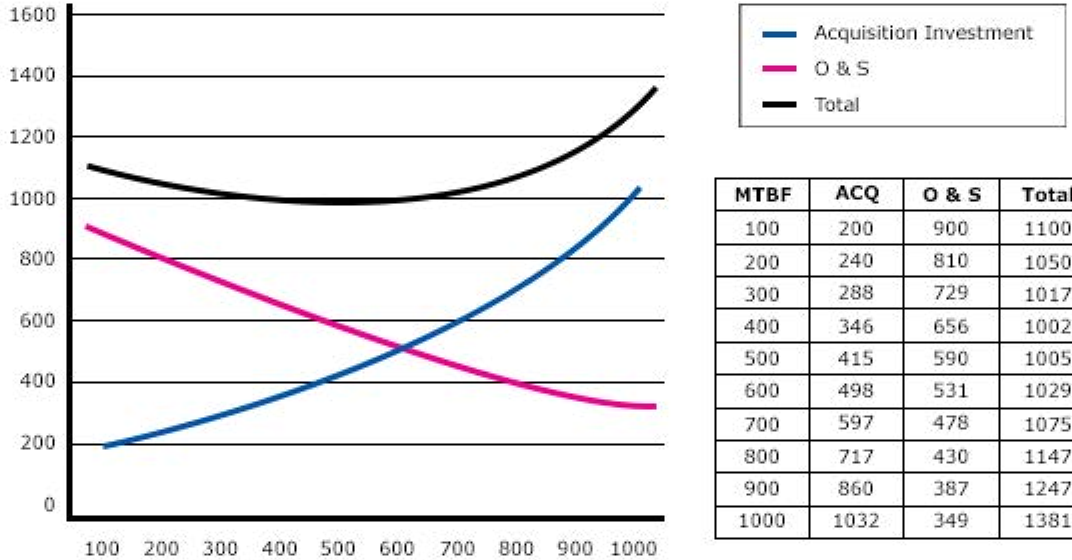
Long Description

Two charts showing the relationship between investment dollars and O&S dollars. The first line graph has a blue line that represents acquisition investment and a pink line that represents O&S. The O&S costs go down proportionately as the investment costs increase. The 2nd chart is a table with the header Mean Time Between Failure, Acquisition Investment Cost, Operating Support Cost and Total. As the MBTF hours and Investment costs rise, the O&S Costs decrease. The Investment Costs plus the O&S costs add up to 1100 in the total column for every item.

Life Cycle Cost Trade-Offs: Case 2

In this notional chart where reliability improvement results in a significant improvement in O&S costs, there is a point where it pays to invest in the improvements. However, there is also a point of diminishing returns. The investment is worth it (up to a point). Finding that point is more theoretical than practical, since getting reliable data in order to determine where the best return exists may be a challenge. The PSM just needs to realize that such a point probably exists. **Select image to enlarge.**

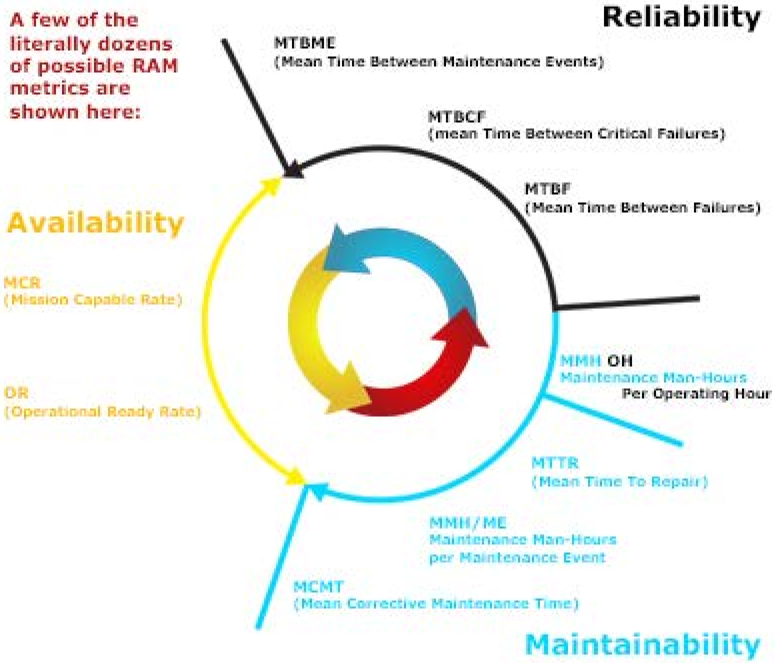


MTBF	ACQ	O & S	Total
100	200	900	1100
200	240	810	1050
300	288	729	1017
400	346	656	1002
500	415	590	1005
600	498	531	1029
700	597	478	1075
800	717	430	1147
900	860	387	1247
1000	1032	349	1381

Case 2: Every 100 hours of improved reliability costs 20% and reduces O&S by 10%.

RAM Terminology

In order to engage effectively with program engineers, the PSM needs to be able to speak their language. Reliability, Availability, and Maintainability (RAM) have very specific meanings to an engineer. Further, each of these three broad areas can be expressed by a number of different metrics. It's important that the PSM recognize, for example, the difference between a reliability metric and a maintainability one. Shown here are just a few of the literally dozens of possible RAM metrics. **Select image to enlarge.**



Design Interface: Availability

Let's look a little more closely at Availability.

Availability can be simply expressed as the percentage of a fleet of systems that are performing or are ready to perform a mission.

How the fleet is defined (i.e., should backup systems be included?), what the term "ready" means, and other issues can add a lot of complexity.

Availability can also be described as a probability that a system will perform its mission when called upon at any random point in time.

Design Interface: Availability, Cont.

Availability is not likely to be used directly in O&S costing but it often determines the level of reliability and maintainability requirements, which are important cost factors.

Availability may be defined as:

- Readiness to perform a mission at a random point in time
- Affected by R&M characteristics

Higher levels of availability may be achieved by:

- Better and more reliable (more expensive) components
- Redundancy
- Improved maintainability

Availability has a complex affect on O&S in that it:

- May drive higher O&S (i.e., increased component costs or redundancy, more sophisticated support equipment, more maintenance personnel, etc.)
- May lead to lower O&S (i.e., higher reliability and better maintainability designed into system without increased costs or manning)

Two Availability Measures

These are the first two availability equations. The first states that for a given calendar time period or "Total Time," the availability of a system or fleet of systems is the portion of the total calendar time for which systems are "Up" or available for performing a mission.

The second equation is another form and can be derived from the first equation by noting that total calendar time is the sum of mean up time plus mean down time.

1. General Availability Expression

$$A = \frac{\text{Total Uptime}}{\text{Total Calendar Time}} = \frac{\text{Mean Uptime}}{\text{Mean Uptime} + \text{Mean Down Time}}$$

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Long Description

Equation stating that for a given calendar time period or "Total Time," the availability of a system or fleet of systems is the portion of the total calendar time for which systems are "Up" or available for performing a mission.

Two Availability Measures, Cont.

1. General Availability Expression, Cont.

The third equation is for inherent availability; this availability measure only considers inherent failures and associated repair times; it does not consider such factors as unverified failures, scheduled maintenance, and logistics delay times. Inherent Availability is very important to the PSM because its two components, reliability and maintainability, are significant O&S cost drivers and the O&S costs associated with them are largely "locked in" during the system design process.

2. Mission Capable Rate

The second availability measure is the Mission Capable Rate. This availability measure is an availability expression that includes only "possessed" systems (excludes back-up systems that may be undergoing depot repair). MCR is generally derived by dividing the total number of assets available for mission tasking by the total assets.

$$A_i = \frac{MTBF}{MTBF + MTTR}$$

Mean time between failures (MTBF)
Mean time to repair (MTTR)

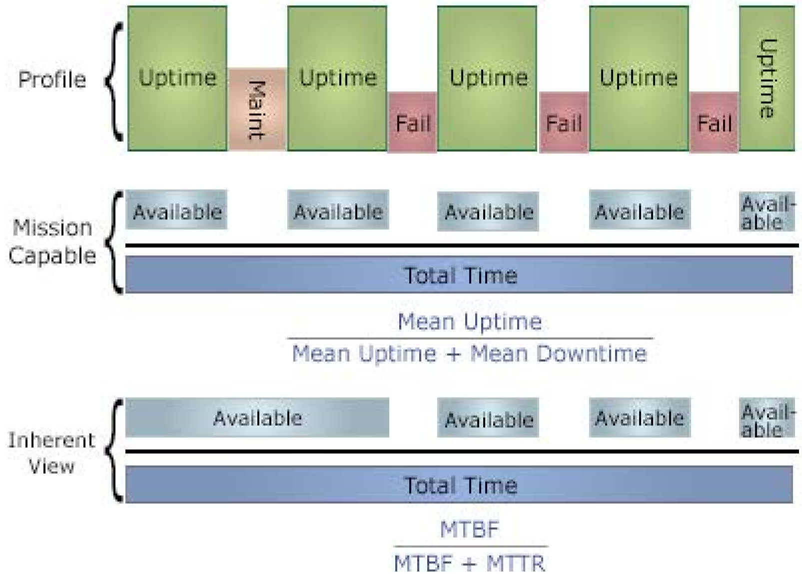
Popup Text

Intrinsic (Inherent) Availability

A measure based on design-controllable (inherent) failures and their associated repair times (excludes such events as no-trouble-found, logistics delay and systems undergoing depot maintenance).

Availability: Mission Capable

The chart below shows the difference in a Mission Capable (top) view of a series of events and the inherent (bottom). In the mission capable view, the scheduled maintenance is counted in the down time. In the inherent model, only unscheduled events count. Either way, it is important to understand the huge impact of the Reliability number, whether expressed as Uptime or as MTBF, has on the Availability metric. Also important here, and with all RAM metrics, is to be sure definitions are clearly understood and agreed to by all the stakeholders. For example, "time to repair;" when does the clock start and when does it end? Or, what constitutes a "failure?" Is it all failures, or just the ones that cause us to be non-mission capable? And who defines "mission capable?" **Select image to enlarge.**



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Long Description

Chart showing the difference in Mission Capable view of a series of events and the inherent view.

Reliability Definition

Now we will move from Availability to Reliability. Reliability metrics are most often expressed as a variation of "Mean Time Between Something Bad Happening." These metrics are usually expressed in hours. The greater the number of hours expressed in the Reliability metric, the lower the O&S cost.

The probability that an item will perform its intended function under stated conditions for a specified interval of time or number of events is:

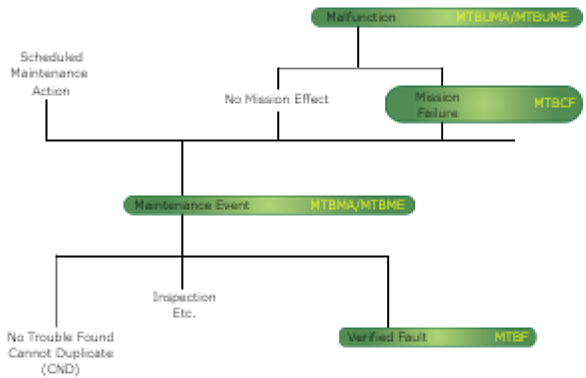
- A quantifiable measure (probability)
- Based on defined performance
- Assumes a set of environmental conditions
- Related to time or specific events

Typical measures include:

- **M**ean **T**imes **B**etween
- Adverse Events (failure, maintenance action, etc.)

Reliability Terms And Maintenance Events

This chart shows one taxonomy of the many events that can happen. For example, if a technician cannot find the fault at the organizational level (i.e., flight line), or if he or she finds the fault (a verified complaint) he or she may fix it in place or remove and replace the failure for further shop-level action. At the shop (intermediate level) the removed item may bench-check okay or, if the failure is verified, it may be discarded, repaired at the shop, or sent back to a depot. What is not shown on the chart are other complications such as the maintenance technician causing additional failures (maintenance induced failures), and the repair or removal of one or more non-failed items. Simple R&M measures may not capture all the subtleties involved with a maintenance event, many of which influence O&S costs. Similarly, if there is no mission effect, depending on how reliability is determined, the system may be deemed reliable, but we will still incur O&S cost for troubleshooting, spares, etc. **Select image to enlarge.**



MTBUMA/MTBUME - Mean Time Between Unscheduled Maintenance Actions/Events
MTBCF - Mean Time Between Critical Failure

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Long Description

Flowchart explaining the process or taxonomy of events. Chart begins at the bottom with No Trouble Found across from Verified Fault. It ends at the top with the Malfunction or Scheduled Maintenance action.

Knowledge Review

You are reviewing a list of possible performance metrics related to Reliability for a Performance-based Product Support contract. Which of the following might you choose?
(Select all that apply)

- [ ] Mean Time to Repair (MTTR)
- [x] Mean Time Between Failure (MTBF)
- [x] Mean Time Between Operational Failure (MTBOF)
- [x] Mean Time Between Maintenance Events (MTBME)

Check Answer

Commonly used Reliability metrics include: **Mean Time Between Failure (MTBF), Mean Time Between Operational Failure (MTBOF), and Mean Time Between Maintenance Events (MTBME).**

Knowledge Review

As a PSM, you are asked to think about Maintainability in terms of Mean Time To Repair (MTTR), and you reduce the amount of scheduled maintenance for a system by 50%, what impact might that have on MTTR?

- [ ] It would reduce MTTR by 50%
- [ ] It would reduce MTTR by some factor, but probably not by 50%
- [x] None. Scheduled maintenance time is not included in MTTR.
- [ ] It would increase MTTR because reducing regular maintenance would inevitably lead to more failures.

Check Answer

None. Scheduled maintenance time is not included in MTTR.

Reliability History of a System

Another important Reliability consideration is the age of the system. The so-called bathtub curve has been devised to represent a typical reliability history of a system.

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Closed Captioning

An important Reliability consideration is the age of the system. The so-called bathtub curve has been devised to represent a typical reliability history of a system. The vertical axis represents failure rate and the horizontal axis is usually calendar time.

When first introduced, a system will have a number of latent defects as a result of design and manufacturing errors. Also there may be failures introduced because of errors of operators and maintenance technicians who are not yet familiar with the system. Thus, the early failure experience of a new system starts off with a relatively high failure rate, which reduces as the latent errors are eliminated and as the operators and maintainers gain experience. This is called the Infant Mortality phase.

Then there is a relatively long period of stability, called the Constant Failure Rate phase in which failures are primarily due to so-called random causes where there is no systemic or pattern failure mode that can be easily corrected. If there a trend towards higher failure rate in a component, hardware, operational or maintenance modifications may be made to correct the problems. This type of reliability corrective action through modifications is reflected in the little "bumps" shown during the constant failure rate period. Also, as failures do occur they are fixed so that the age of the failed item may be restored to new condition through replacement or there is a partial renewal through some kind of repair. The mixture of ages tends to keep the failure rate constant even if specific components may be wearing-out.

However, eventually a system gets to be so old that the wear-out mechanism or the results of such deteriorating conditions as stress-corrosion cannot be overcome by modifications and replacement and the failure rate starts to increase. This is called the Wearout phase. If we substitute the term "cost" for "failure rate" on the vertical axis, the same curve applies. Newly introduced systems will generally incur increased cost until all the "bugs" are worked out. Similarly, obsolescence and diminishing manufacturing sources and material shortages will drive up the cost as the system ages.

Long Description

Graph showing the bathtub curve for system reliability.

Using the Bathtub Curve Concept

In order to implement the Bathtub Curve concept, it is important to consider the following three factors:

1. Accurate interpretation of reliability data of development tests.
   A. Development items typically have lower than steady-state reliability.
   B. How much improvement can we expect?
2. Accurate interpretation of reliability data of fielded systems.
   A. Avoid misusing data.
3. Accurate adjustment of O&S costs for analogous systems.
   A. Is analogous system in steady-state period?

Using the Bathtub Curve Concept, Cont.

You will be able to use data from fielded systems to project the reliability of a new system. As always, caution is required. If the fielded system is very new or very old you may not want to use that data or at least be aware that adjustments will have to be made. If an estimate is to be made that covers either the infant mortality period or the wear-out period, then data reflecting the steady-state period will have to be adjusted accordingly to reflect the higher failure rates for early or very late operations.

The notion of "maintenance-creep" is sometimes used to reflect the wear-out period. One fairly simple way to express this creep is to assume that after a certain number of years the failure rate increases by X% per year.

Note: For O&S costing purposes, there may be a creep or increase in other cost elements. For example, an increase in costs of repair parts as a result of a decrease in the number of suppliers for the older system.

Reliability's Impact On O&S

Reliability is one of the most significant factors influencing O&S costs. If there are fewer failures, then fewer resources will be required to restore failed systems to operational status. Reliability has two effects on O&S:

Primary Effects

- Labor to fault isolate, remove, replace, and repair
- Consumable and repair parts

Secondary Effects

- Repair part storage and transportation
- Test and other support equipment (deployability)

Knowledge Review

You are explaining the Bathtub Curve to one of your team. In order to test her comprehension, you ask, looking at the Curve, what might be the direct result of improved system reliability? You're happy when she replies:

- [x] Reduced amount of labor required to fix failures
- [ ] Reduced order and shipping time
- [ ] Reduced time to affect repairs
- [ ] Reduced investment cost

Check Answer

Reduced amount of labor required to fix failures is a direct result of improved system reliability.

Maintainability Definition and Metrics

Now that we have covered how Reliability impacts O&S, let's take a look at Maintainability.

Maintainability is the relative ease to restore an item to a specified condition when maintenance is performed by skilled personnel using prescribed procedures and equipment. Maintainability:

- Is quantifiable in terms of labor effort and other support requirements
- Includes both preventative and restorative efforts
- Presupposes defined skill levels, procedures, and tools

Typical Metrics of Maintainability include:

- Diagnostic measures: % faults accurately detected and identified, false alarm rates, retest-ok (RTOK)
- Workload: Mean Repair Time, Mean Time To Repair, and Mean Maintenance Time are the most common types of workload

Maintainability Impact On O&S

When a PSM is tasked with O&S cost estimating, he or she must take into consideration the ease with which a system can be maintained in an operating condition or the ease with which it can be restored to an operating condition after failure is characterized by its maintainability. Both scheduled and unscheduled maintenance activities are considered.

The PSM must pay attention to measures of maintainability which include factors related to diagnosing and isolating a failure, restoring a failed system to operable condition through repair or replacement, and checking the goodness of the maintenance action.

It also includes the preventive maintenance activities needed to keep a system operational. Maintainability primarily influences maintenance manpower needs but also can impact training and support equipment costs.

Maintainability Impact On O&S, Cont.

Similar to reliability, maintainability can also influence the quantity of systems needed to meet operational requirements. Maintainability has two effects on O&S:

Primary effect on operating costs

- Better diagnostic tools (built-in/internal and external)
- Effort to repair a defect
- Reduce false failures
- Reduce unscheduled maintenance, inspections, etc.

Secondary effect on operating costs

- Support equipment requirements
- Improved maintenance access to systems may reduce maintenance-induced repairs
    - Repair parts
    - Difficult to quantity

MAINTAINABILITY

Maintainability Effects On Personnel

Personnel categories include direct maintenance and support personnel. Maintainability primarily influences the former. For support personnel, there generally is a fixed cadre required at some organizational level (i.e., a squadron) and another portion that may be based on the quantity of direct maintenance personnel and other factors.

For example, there will usually be a maintenance officer and logistics or supply officer. How big their staffs are may be a function of how many direct technicians are required. Usually there are service guidelines available to help set up the support personnel complement for a new system or the personnel assignments related to similar fielded systems can be used as a starting point.

Maintainability Effects On Personnel and O&S Costs

The key point here for O&S cost is that investments in improvements in maintainability should reduce O&S costs (most notably maintenance personnel), but the overall impact on O&S costs is often affected by other factors and is more complicated. These factors include:

Categorize Total Unit Personnel

- Crew
- Maintenance
- Supporting personnel such as administrators, supply, medical, etc.

Other Considerations that May Negate Full Benefit

- People are "lumpy" (You cannot have 1.5 people)
- Personnel systems cannot provide all E-7s (retirement pay for personnel retiring with 20 years)
- People have limited skills (electronics technician cannot fix engines)
- Maintainers do more than just maintain

X% improvement in maintainability yields less than X% reduction in O&S costs

- Even less than X% in maintenance personnel costs

Effects Of R&M On Unscheduled Maintenance

This simple equation reflects the major impact R&M has on O&S costs, namely the cost to repair failures, equal to the number of failures expected in a defined time period multiplied by the cost per failure. The former is primarily influenced by the reliability characteristic and the latter by the maintainability characteristic. However, we have to complicate the issue by adding in the training, support equipment, R&M modifications, and other costs that are directly or indirectly impacted by R&M.

System Complexity (Cost)

Inventory & OPTEMPO

System Use

Unscheduled Maintenance Cost = *f* {(Failures) x (Cost per Failure)}

Reliability **Maintainability**

Operating Environment

D

Long Description

Equation that says Unscheduled Maintenance = number of expected failures in a defined time period multiplied by the cost per failure.

Effects Of R&M On Unscheduled Maintenance, Cont.

For example, if a design introduces a new maintenance process that entails a prognostic process for removing items that are believed to be incipient failures, then there may be a significant impact on the training required to ensure that good items are not removed prematurely.

One of the cost elements that may have to be considered is software reliability which can fall within the R&M improvement category.

The frequency and cost of scheduled major inspections and overhauls is another major O&S cost activity that is highly dependent on R&M characteristics.

Requirements, Contractual, and Field Differences

A commonly used method for estimating R&M parameters is to use the values in requirements or contractual documents or in contractor studies as starting values.

If one wanted to use those values as a starting point, it would be wise to find the source of the values and get as much information as possible about their derivation to determine:

- if they are simply the wishes of the user
- if they are based on contractor analyses or sales briefings
- if they are based on analysis of similar systems, technological improvements and good science

Requirements, Contractual, and Field Differences, Cont.

As a PSM you must scrutinize, with care, values based on competing contractor estimates.

A contractor's prime motivation is to secure the development or production contract and having R&M estimates lower than the user expects or needs is not likely to help his case.

The cost analyst must also be careful to distinguish between R&M requirements that specify values that a contractor is required to meet through manufacturing or factory tests from that to be seen in the field.

Requirements, Contractual, and Field Differences, Cont.

Manufacturing tests are often called R&M demonstration tests and the values to be demonstrated might exist in early planning documents, then in Request For Proposals (RFPs), and finally in procurement contracts. R&M demonstration requirements and the associated tests are designed to determine inherent reliability and maintainability under well-controlled conditions. For such tests, many failures or repair times are waived for various reasons.

For example, the contractor may claim that a design problem that has caused one or more test failures has been found and will be implemented, and if such a claim is accepted all related failures are waived. This often results in an optimistic—sometimes very optimistic—estimate of what the true field R&M will be.

For very early stages, estimates may have to be based on requirements and contractor estimates. It is also essential to understand the difference between Contracted, Factory-tested and Field Reliability. Differences include:

- Failure and repair time definitions and waivers
- Operational and support conditions

Requirements, Contractual, and Field Differences, Cont.

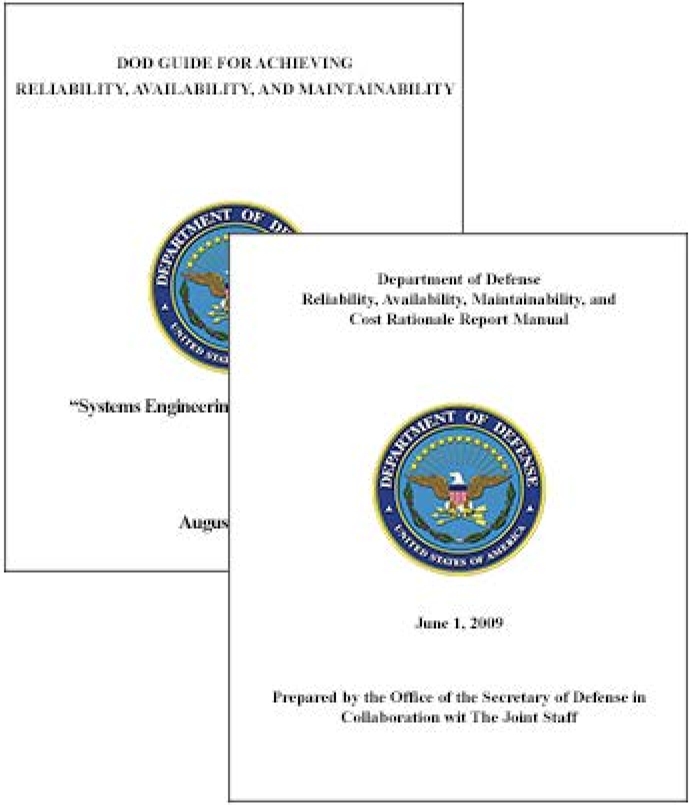
In the maintenance environment, there are many differences between factory and field conditions that can lead to optimistic results regarding the true maintainability. The chart below shows some of the typical differences. Similar differences can exist for reliability demonstration tests versus field operation. Some ratios of field to demonstrated failure rate have previously been as high as 3:1.

Factory VS. Field Maintainability	
Factory M Test	**Field Maintainability**
72 degrees	28 degrees and snowing
Well lit work area	Night-time – poorly lit
Highly skilled technician	Technician just out of school
All tools and manuals available	Can't find all the tools needed
Test equipment perfect	Test equipment erratic
Known fault inserted	Fault not anticipated
Freshly calibrated systems	Unknown degradations

The RAM Guide and the RAM-C Manual

Considering the importance of RAM on sustainment planning and O&S cost, the better-informed the PSM is on this topic, the better off he or she will be. These following two documents are valuable aids:

1. The RAM Guide is a useful tool for understanding the true design interface aspects of Reliability and Maintainability. It provides PSMs, PMs, and engineers useful information to help plan for and design RAM into systems early in the program.
2. The RAM-C Manual, and more particularly the RAM-C Report itself, gives the PSM valuable insight into the decision-making and cost projections that occur during the Analysis of Alternatives. It is designed to help capability document requirements writers and supporting engineering organizations think through top-level sustainment requirements early in the program.



R&M Data Sources

R&M data systems exist in the Air Force and Navy. The Air Force data is primarily obtained through the Reliability Maintainability Information System (REMIS).

The Navy system, Navy Aircraft Logistics Data Analysis (NALDA), provides R&M information for Navy/Marine aircraft systems and the 3M system, Material Maintenance Management, has detailed R&M data for all Navy/Marine systems. (Web site access to authorized users is available.)

There is no centralized R&M data source for Army systems but such organizations as the Army Material Systems Analysis Activity (AMSAA) at Aberdeen Proving Grounds and individual program and technical offices often have R&M data. The Reliability Analysis Center (RAC) at Rome Air Development Center is a centralized agency for coordinating R&M data systems and methodology.

R&M Data Sources, Cont.

These R&M data sources along with O&S data systems, AFTOC for the Air Force, OSMIS for the Army and VAMOSC for the Navy/Marines can provide valuable data to assist in R&M estimation and O&S costing. As with any data source, the conditions under which data are collected should be sought and consideration given to anomalies which can distort the data.

Thus, it is probably a good idea to use more than one year of data if possible but not so long a period that the data may not represent current systems or be a mix of many different configurations and operational situations which cannot be easily sorted out. Two to three years of data appears to be a good compromise.

Knowledge Review

As a PSM, you are asked to report on your R&M sources of data. Which ones will you choose as the basic sources of data for your reports? (Select all that apply)

- [x] REMIS
- [x] NALDA
- [x] AMSAA
- [ ] RAM Guide

Check Answer

REMIS, NALDA, and AMSAA are some basic R&M data sources.

Lesson Summary

Our objectives in this lesson were to explore the various aspects of Design Interface such as Reliability and Maintainability (R&M) to see how they affect O&S cost. We also looked at Availability and how R&M play in calculating the various types of Availability. Remember that there is an Availability Key Performance Parameter and Key System Attributes for Reliability and O&S cost. All these concepts are closely related and all are driven by the design of the system.

Lesson Summary, Cont.

Congratulations! Now that you have completed the Design Interface lesson, you should be able to:

1. Describe basic Reliability and Maintainability (R&M) terminology and relationships.
2. Describe how R&M affects Operating and Support (O&S) cost estimates.
3. Describe basic R&M data sources.

Lesson Completion

You have completed the content for this lesson.

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