Tool Box Training – Criticality Assessment

"Making the right decision at the right time"

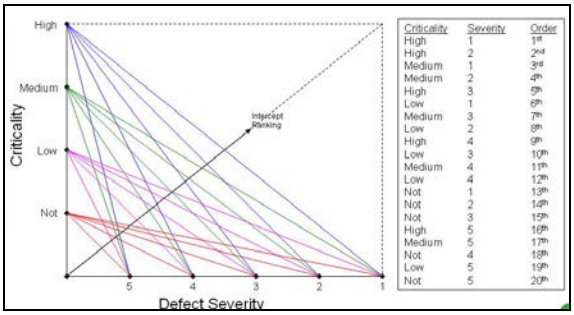
The main purpose of a criticality assessment is CONSENSUS.

When it comes to the allocation of resources, interdepartmental consensus with respect to asset criticality is one of the cornerstones upon which interdepartmental relationships are built. The other cornerstones are common goals and mutual respect.

What is Criticality and Why is it so Important?

A Criticality Assessment is a process for determining the relative ranking of items in a system. The purpose of ranking the items is to determine which items get preferential treatment with respect to resource allocation.

In the industrial setting, these items are generally assets and the resources are labor, materials and schedule priority.



Criticality	Severity	Order
High	1	1st
High	2	2nd
Medium	1	3rd
Medium	2	4th
High	3	5th
Low	1	6th
Medium	3	7th
Low	2	8th
High	4	9th
Low	3	10th
Medium	4	11th
Low	4	12th
Not	1	13th
Not	2	14th
Not	3	15th
High	5	16th
Medium	5	17th
Not	4	18th
Low	5	19th
Not	5	20th

General Rules which must be followed:

1. The criticality assessment process is accomplished by asking a series of questions which represent the interests of different aspects of the operation.
2. There is a ***very common misconception about the use of the words criticality and the word importance.*** The misconception is that they are synonyms. This is not the case. They are not synonyms. They are related, but not the same.
    a. **Importance** speaks to precisely the common definition of the term. Assets whose fail more immediately and/or more severely impacts the desired state are said to be the most important.
    b. **Criticality** on the other hand speaks to the combination of importance and failure rate. This creates a scenario whereby one machine may in fact rank lower on the importance scale, but as a result of an increased failure rate, actually rank higher on the criticality assessment.

Guiding Principles

1. The criticality ranking isn't merely an academic exercise. It is a necessary part of managing a group of assets when there isn't an unlimited supply of resources.
2. The criticality ranking enables the allocation of these scarce resources in such a way as to affect the most positive impact on the production capacity of the facility.
3. Examples of this enabling can be seen in the development of job plans, the scheduling of work and the machines that are chosen to be on the preventive maintenance and predictive maintenance programs.
4. The categories of questions for a criticality assessment typically include: production, maintenance, safety, procurement, engineering, etc. The answer to the questions from these different categories creates a numerical ranking, differentiating one asset from another.

Proper Design of a Criticality Assessment System

1. The proper design of a criticality assessment system begins with a discussion of what items are to be assessed.
2. Assessments are usually performed at either of three levels: system, asset or failure mode.
3. System criticality is often performed first at plants that have no criticality assessment at all
4. At these facilities it is oftentimes unclear as to which systems are most mission critical.
    5. Different people in the facility will all have their own ideas, but these ideas are often in conflict. This creates tension when it comes time for resource allocation. Tension created by the

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GP*Allied*
4200 Faber Place
Charleston, SC 29405
Office (843) 414-5760
Fax (843) 414-5779

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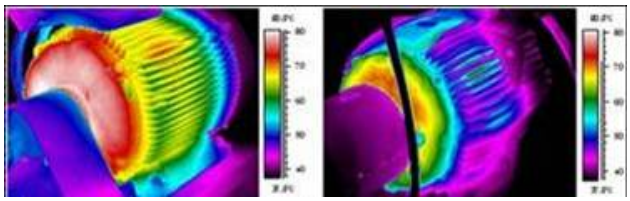
constant tug-of-war for valuable resources like manpower and money for repairs.

6. A system level criticality assessment will usually draw out some of these conflicting views and quickly provide a scenario whereby consensus is drawn and the path forward becomes a lot clearer.

Taking it to the Failure Mode Level

(Failure Mode – "how something fails")



a. There always exists, in every plant, a group of assets which, by means of their importance and their failure rate, are the most critical in the plant.
b. These assets are generally referred to as the bad actors.
c. They earn their moniker by the amount of headaches they cause plant operations.
d. For these assets, more detail is required in the criticality assessment.
e. This time, the criticality assessment will jump straight to the failure mode level.
f. This assessment process is known as Failure Mode Effects and Criticality Assessment or more simply FMECA.
g. A FMECA should be performed on the assets that ranked in the top 5-20% of the asset criticality assessment.
h. FMECA is a vital part of understanding machinery failures and developing effective and efficient equipment maintenance plans (EMP).

Performing the Criticality Assessment

1. Differentiating Factors

As you start your journey to perform a criticality assessment on the equipment in your facility, keep in mind that the way to accomplish this is to focus on what makes one piece of equipment different from another. Or another way to say this is to determine the differentiating factors that each machine possesses. Some of those differentiating factors are discussed below.

Asset maintainability

a. Differentiate machines based on their maintainability. All other things being equal…
b. Assets that do not require a ladder to work on should score lower on criticality than those that do.
c. Assets that have standardized parts should score lower on criticality than those that do not.
d. Assets that have more modern control systems on them should score lower than those that do.

Redundant equipment

a. Redundancy, the bane of any reliability engineer when it comes to criticality assessment. Do I score it exactly the same as the in-line spare or do I score it differently?
b. The question remains, is the criticality ranking index number supposed to be the same for two identical assets who act as each other's in-line spare?
c. It depends on the ***operating philosophy of the asset owners.***
d. We assume two identical assets wear at the same rate so asset criticality ranking is simple.
e. This is not the case for as much as 89% of the failures because they are random. Admittedly, there are specific situations where wear has a direct correlation to time in operation.

Analysis of the Criticality Assessment Results

a. During the criticality assessment process, analysis of the results should take place on a very regular basis to ensure that a quality result is being produced.
b. An excellent way to quickly determine the quality of the assessment is to consider the shape of a frequency distribution graph of the results.

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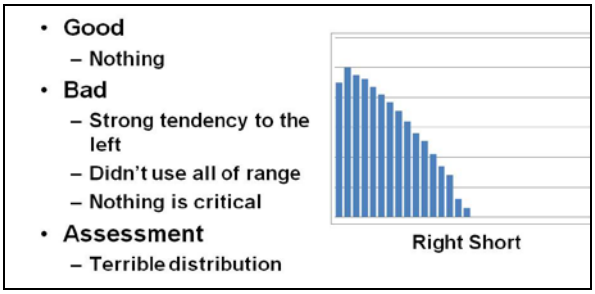
c. A study in the analysis of the results of a criticality assessment is something of a study in statistics.



Example of QA/QC Results

d. A qualitative study, but a study none the less. It is labeled qualitative due to the fact that the shape of the distribution is studied to determine whether or not, the questions and answers were structured to adequately reflect the true nature of the inter-relationship of the assets in the facility.

Using the Criticality Assessment Results

Having finished the criticality assessment process, what is to be done with the results? It wasn't merely an academic exercise.

The results have a variety of specific uses, all of which fall into one encompassing category, resource allocation.

1. **Resource Allocation**
Resource allocation, with respect to maintenance and reliability, is the process of managing to use of time, labor, parts, materials and tools to increase the conditional probability of reliable operation.

2. **Equipment Maintenance Plan**
The equipment maintenance plan (EMP) is a list of the preventive maintenance (PM) and predictive maintenance (PdM) tasks that are going to be performed on the asset base, the frequency at which they are going to be performed, by whom and how long each task will take.

The determination of the amount of PM and PdM that will be performed is largely a function of criticality. ***For the top 5-20% of the asset base, the failure mode criticality will determine the PM and PdM tasks to be performed. For the balance of plant, the asset criticality will be the deciding factor.***

3. **Maintenance, Repair and Operational (MRO) Supplies**
Like determining the EMP, criticality plays a very large role in determining MRO supplies stocking levels.

Assets with higher criticality ranking warrant higher levels of in-stock parts. While the EMP is in place to guard against unplanned downtime, ***surprises happen as a result of random acts creating machinery failure. When these arise, the most critical assets will need ready access to spare parts.***

Ongoing Management of the Criticality Assessment Database

The criticality ranking database should be a living document. Living document means it has to be updated as changes to the environment happen.

These changes could be as large as a shift in the market or as small as a change in the failure rate of a machine as the result of a root cause analysis (RCA) effort. Either way, for the criticality assessment to remain a valid tool to be used for resource allocation, it has to be kept up to date.

The ***reliability engineer would typically be responsible for changes to an individual machine's criticality assessment.***

Changes to the entire criticality database, as a result of a drastic shift in the business market would require the criticality assessment team to reconvene.

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