Reliability Prediction Analysis: More Than MTBF

Reliability Prediction analysis is one of the most common techniques used by engineers for reliability assessment. Reliability Prediction provides a methodology for predicting the failure rate or MTBF (Mean Time Between Failures) of a product or system. Typically, Reliability Predictions are performed early in the design cycle to evaluate predicted product reliability. The results of the analysis can then be used to target potential areas for improvement. This can be critical in cases where MTBF goals are contractually mandated or required for compliance. However, even without contractual requirements, many organizations use Reliability Predictions to design-in reliability in order to ensure their products meet performance objectives.

RELYENCE CORPORATION

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What are Reliability Prediction Standards?

Reliability Prediction analyses are performed based on a standard that offers a set of mathematical formulas to model and calculate the failure rate of a variety of electromechanical components. The overall failure rate of a system or product is the summation of the underlying component failure rates. Sometimes this overall failure rate is modified based on additional considerations, such as real-life data captured from prior products or data accumulated from lab testing.

To learn more about Reliability Prediction, review our informative blog post.

There are several available and commonly used Reliability Prediction standards. The most widely accepted standards are:

- MIL-HDBK-217
- Telcordia SR-332
- 217Plus
- China's GJB/z 299

ANSI/VITA 51.1 is also a standard that utilizes MIL-HDBK-217 as a basis and updates the failure rate calculations based on more recent device trends.

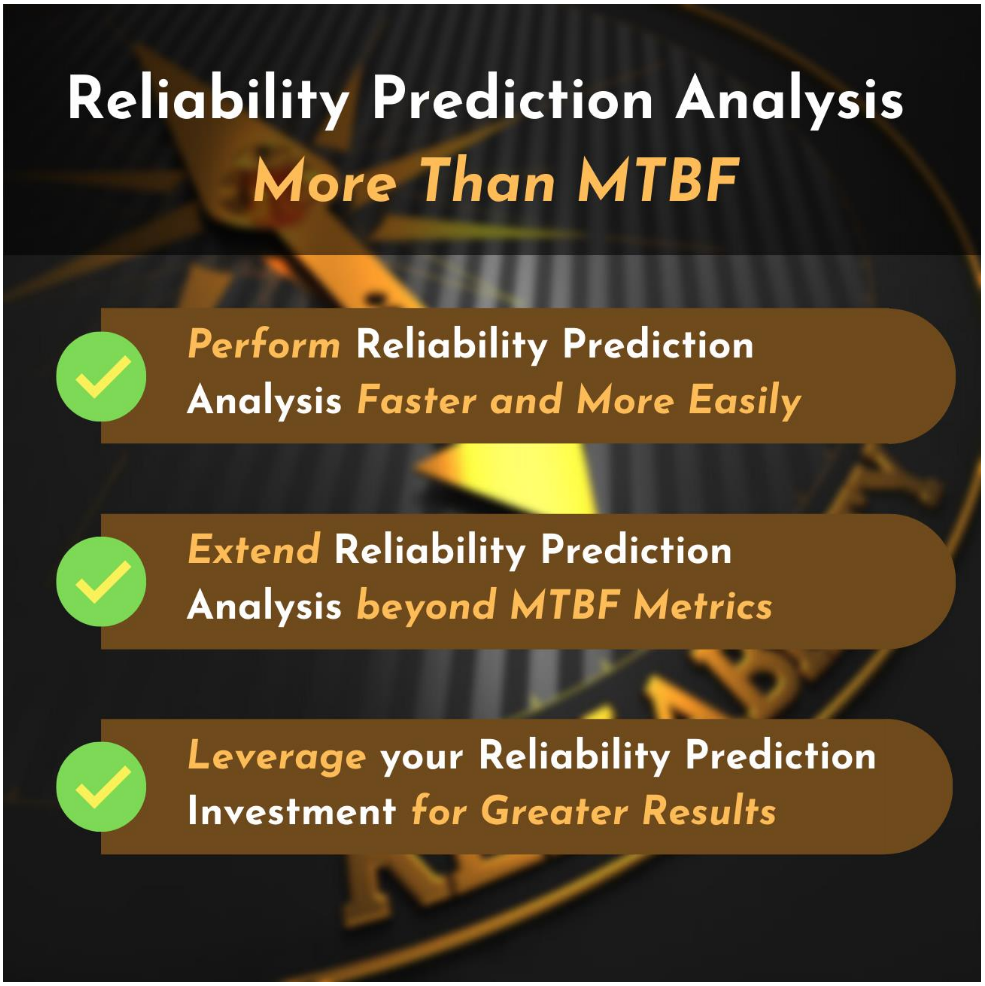
For a detailed review of Reliability Prediction standards, review our in-depth guide.

Reliability Predictions: Beyond the Standards

The core objective of Reliability Prediction analysis is to provide an estimate of your product failure rate. This is an important element for reliability assessment and continuing improvement efforts. However, the investment in Reliability Prediction analysis can go beyond failure rate and MTBF assessments. This paper will look at various ways you can extend your Reliability Prediction analyses to gain even more benefit from this useful technique.

We will delve into the various ways Reliability Prediction analyses can be augmented for greater efficiency and effectiveness:

- We'll start with techniques that enable you to perform your Reliability Prediction analyses *faster* and *more easily*.
- In the second section we'll discuss the most common ways Reliability Prediction analyses can be *extended* to include other types of analyses.
- In the last section, we'll look at ways you can *leverage the benefits* of Reliability Prediction analyses into your overall reliability and quality program.



Performing Reliability Prediction Analyses Faster and More Easily

The process of performing Reliability Prediction analyses can be a cumbersome task. Essentially, to complete an analysis, you need detailed data about your equipment and all its components. Sometimes this information is unavailable during the early design stage. Even if the data is available, data entry can become a tedious task. There are several ways to lessen these burdens.

#1: Employ Parts Count Analysis

In the situation where the design is not yet complete, you can still perform Reliability Prediction analysis. Importantly, Reliability Predictions can be very helpful at the early design phase. Reliability Prediction helps you to recognize areas of your design that may be problematic from a reliability standpoint. For example, you may see that a particular subassembly or component is driving up the overall failure rate of your design. In this case, you can reexamine the design and make changes to stay within your reliability goals.

Using Reliability Prediction Parts Count Analysis in Early Design

In the preliminary design stage, it is useful to employ the Parts Count analysis methodology. Parts Count analyses are intended for use during the early design stage when the overall component make up of a system may generally be known, but specifics are not yet available. Parts Count methodology is used in contrast to Part Stress, which is used when all or most data required for analysis is known. Not all standards have both methodologies defined. However, several commonly used standards, such as MIL-HBDK-217, 217Plus, and China's GJB/z, have well-defined Parts Count techniques.

When selecting the Parts Count analysis, significantly less data is required. For example, here is the data requested when performing Parts Count analysis for an Integrated Circuit when using the MIL-HDBK-217 standard:

Here is the same component information requested when performing Part Stress analysis:

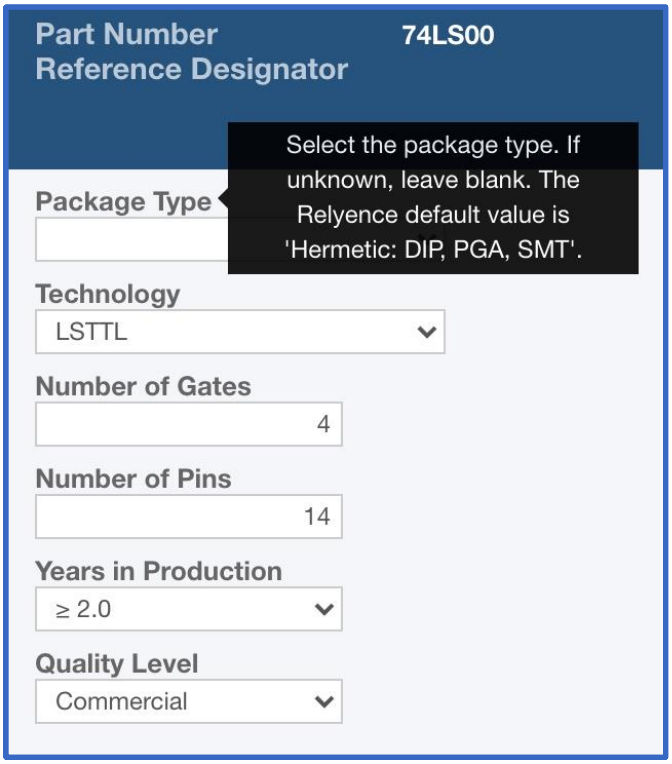
You can utilize the Parts Count methodology to provide a faster and easier failure rate assessment. It also does not have to be limited to early design - you can use it at any time if you prefer. The overall failure rate values must be considered more of a general estimate and not a precise indicator. One example of the usage of Parts Count methodology is to quickly compare product designs. Using Parts Count offers a quick way to assess one design over another to determine if one design offers a better predicted failure rate.

#2: Use Default Data Values

If you decide not to employ Parts Count analysis, you can still use the more common Part Stress analysis to perform early design stage analyses by taking advantage of default data values.

In Reliability Prediction analysis software such as Relyence, you are not required to enter all the data parameters needed for Part Stress analyses. This is very helpful in the early design stage when not all data parameters are known. For data values left blank, Relyence will use built-in default values.

By design, Parts Count methodology computes failure rates by utilizing average values for data parameters. For example, when Parts Count is in use, operating stress values, such as power, are assumed to be 50% of maximum. Relyence Part Stress analyses will use the Parts Count average values as the defaults for data values not entered, allowing you to easily perform MTBF calculations with any amount of data you have.



Relyence Reliability Prediction Part Stress uses built-in default values data not yet available.

This offers two additional benefits when performing Reliability Prediction analyses with software tools such as Relyence. First, you can start off with a Part Stress analysis, enter as much data as you have, and then go back and continually update as information becomes available. This enables you to refine your analyses over time as your design becomes more finalized without the need to wait until you have all data necessary data parameters. Secondly, if you are using Parts Count in conjunction with Part Stress, you can easily move from a Parts Count analysis to Part Stress. As your design is refined and more data parameters are known, simply change over to Part Stress from Parts Count and enter actual data parameters. In either case, as more and more parameters are obtained, your Reliability Prediction analysis becomes more accurate.

In addition, tools such as Relyence Reliability Prediction software allow you to define your own customized default values. For example, perhaps you want to perform early analysis using higher values than average 50% settings. Using customizable defaults, you can change the built-in defaults to values that better suit your requirements.

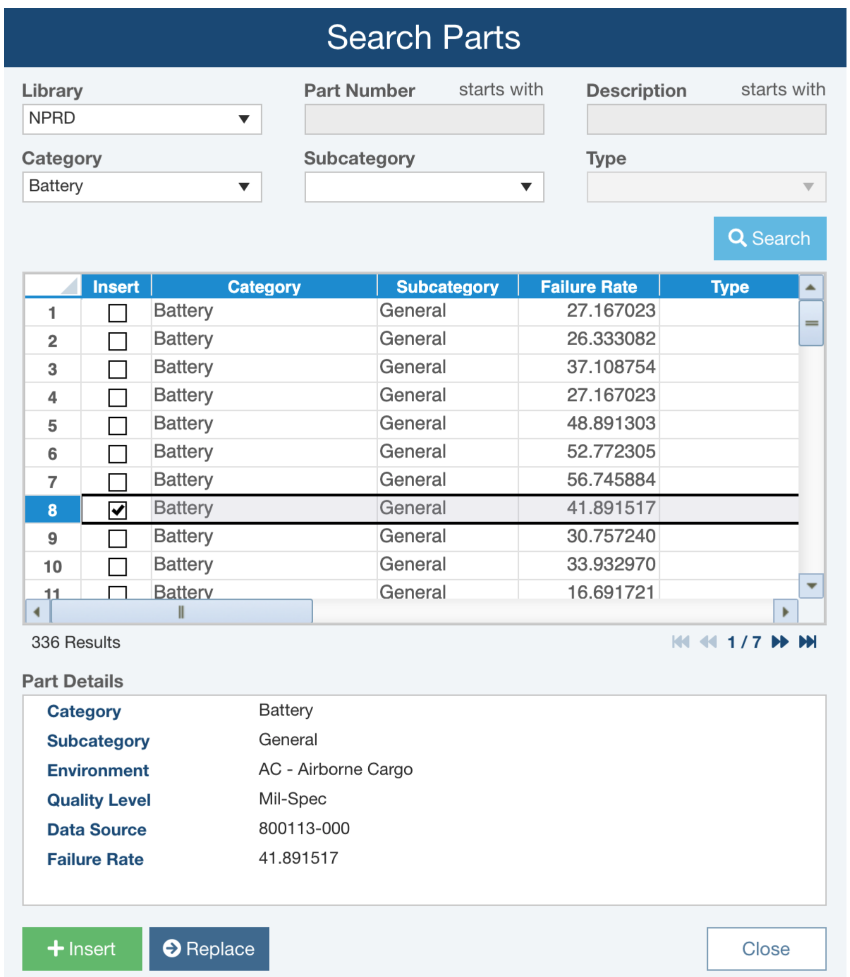
Using default values with a Part Stress methodology can greatly improve your product design efficiency. You can begin Reliability Prediction analyses early in the design stage before all data parameters are known and get an early indication of potential problem areas. You then can modify and adapt your design as needed to keep reliability goals intact. This ability to design-in reliability is one of the most significant advantages of Reliability Prediction analysis.

#3: Take Advantage of Component Libraries

One of the most time intensive elements of performing a Reliability Prediction analysis is finding and entering all the data associated with the components of your system. As you can see from above, you may need to enter a great deal of information about each device. In the example above for an Integrated Circuit calculation using MIL-HDBK-217, the package type, technology, number of pins, number of gates, years in production, quality, and temperature are all required. Clearly, making this data entry process most efficient is of the utmost importance.

Databases of Component Failure Rates

The component databases NPRD (Non-electronic Parts Reliability Data) and EPRD (Electronic Parts Reliability Data) are often used in conjunction with the Reliability Prediction standards to augment prediction analyses. The NPRD and EPRD databases include failure data on a wide range of electrical components and electromechanical parts and assemblies based on actual field-based usage. You can use this failure data in your Reliability Prediction analyses by searching for a matching component in this large database and adding it to your analysis. In this case, instead of component parameter data being used, the actual field-based failure rate will be retrieved and applied.



Searching the NPRD Library in Relyence Reliability Prediction.

Parts Libraries for Off-the-Shelf Components

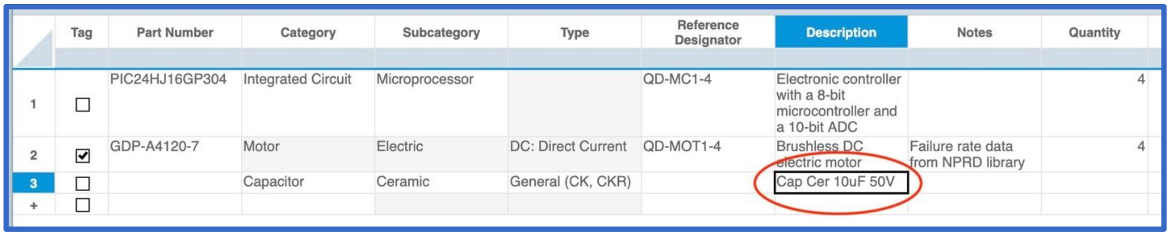
Many devices used in systems today are components manufactured by well-known companies such as Motorola, Texas Instruments (TI), and others. The data parameters for these components are therefore known and can be easily found. Reliability Prediction analysis software such as Relyence offers built-in component libraries with these widely available devices and their data parameters readily available. For example, you only need to enter the part number “74LS00” and most of the information needed is automatically retrieved. Design specific data, such as operating stresses, will need to be entered; however, a large majority of the data needed is known and easily obtained. Taking advantage of these built-in component libraries significantly speeds up the data entry process.

Customized Parts Libraries

In addition to commonly known devices, you may have a number of components that you reuse in your products. In these cases, by using Reliability Prediction software like Relyence you only need to enter the data parameters once. Once entered, you can save information to your own Parts Libraries and retrieve it for reuse just like built-in libraries. Customized Parts Libraries are an add-on to the built-in libraries, allowing you to speed up the data entry process.

#4: Utilize Intelligent Part Mapping

For maximizing data entry efficiency when using Relyence Reliability Prediction, you can take advantage of the *Intelligent Part Mapping™* capability. This unique-to-Relyence feature reviews the part description text and extracts as much information as possible.



	Tag	Part Number	Category	Subcategory	Type	Reference Designator	Description	Notes	Quantity
1	☐	PIC24HJ16GP304	Integrated Circuit	Microprocessor		QD-MC1-4	Electronic controller with a 8-bit microcontroller and a 10-bit ADC		4
2	☑	GDP-A4120-7	Motor	Electric	DC: Direct Current	QD-MOT1-4	Brushless DC electric motor	Failure rate data from NPRD library	4
3	☐		Capacitor	Ceramic	General (CK, CKR)		Cap Cer 10uF 50V		
+	☐								

As shown above, if you enter “Cap Cer 10uF 50V” in the Description field, Relyence will determine that the component is a 10 uF ceramic capacitor with a voltage rating of 50 volts. Intelligent Part Mapping is one of the acclaimed capabilities of Reliability Prediction analysis developed by Relyence. It significantly improves the data entry process, both during direct data entry and when importing data from outside sources.

#5: Develop Knowledge Banks

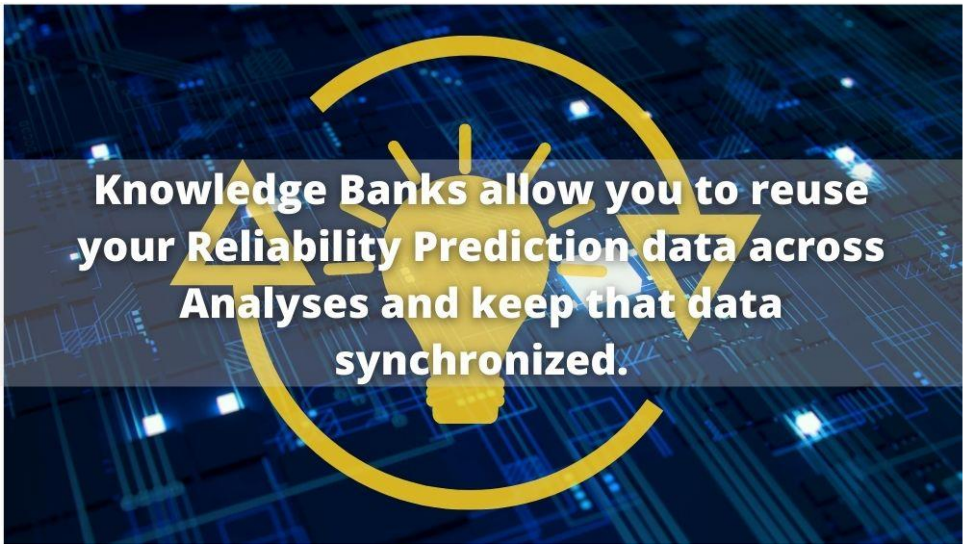
Since its introduction, the Relyence Knowledge Bank™ innovation has been widely praised for its power, flexibility, and efficiency. Over the years it has become one of the standout features of the Relyence platform. You can take your Reliability Prediction analyses to a whole new level with improved productivity that can be achieved by using Knowledge Banks.

The core function of the Knowledge Bank is to enable you to capture and reuse your Reliability Prediction data. For example, you may have a subassembly used across multiple product lines. Or you may use a subassembly from a prior design in a new design. In these cases, the Knowledge Bank replaces the cumbersome and error-prone copy-and-paste method of managing reused data. Essentially, you store the information once in the Knowledge Bank and then reference it where needed.

Beyond the aspect of reuse without data reentry, the Knowledge Bank also offers the ability to keep modifications made to the stored data *in sync* wherever used. For example, perhaps you have changed suppliers for a particular component in one of your subassemblies. When using the Knowledge Bank, you simply change this information in one place. The updated information can then be pushed out to all applicable analyses. You can choose how and when these push updates occur so that you can control and manage the data update process.

Using the Knowledge Bank in Reliability Prediction for the management and control of reusable data is a simple three-step procedure:

1. Add the subassembly to the Knowledge Bank.
2. Reference the stored subassembly in all analyses where it is used.
3. Keep changes made to the subassembly in sync across all analyses by using the Knowledge Bank Push feature.



It is easy to see how the value of the Knowledge Bank grows over time. As you continue to add to your bank of reusable assemblies, your future analyses can be completed much more efficiently. Not only does it improve the speed of performing your Reliability Prediction analyses, but it also means you have more confidence in the consistency of your data. Because the Knowledge Bank provides a central repository for information that is controlled and managed, you do not have to worry about keeping track of various "versions" of your data.

The Relyence Knowledge Bank has an array of capabilities including:

- You can have multiple Knowledge Banks and store and retrieve data from any or all.
- You can control all aspects of changes made via the Push function. You can see a list of pending push changes and opt to bypass or delay as needed.
- You can enable notifications to allow team members to be notified of Push changes.
- You can view a list of Knowledge Bank data usage to see analyses where data is tied to a Knowledge Bank.
- You can extend Audit Trail tracking to Knowledge Banks.

For more information on using Knowledge Banks in Relyence Reliability Prediction with an example walkthrough, see our instructive blog post.

Extending Your Reliability Prediction Analyses

Now that we have described the methods that enable you to perform your Reliability Prediction analyses more efficiently, let's look at ways they can be extended for more in-depth studies. These add-on analyses can be done based on the information already available in Reliability Prediction.

#1: Analyze Overstressed Conditions with Derating Analysis

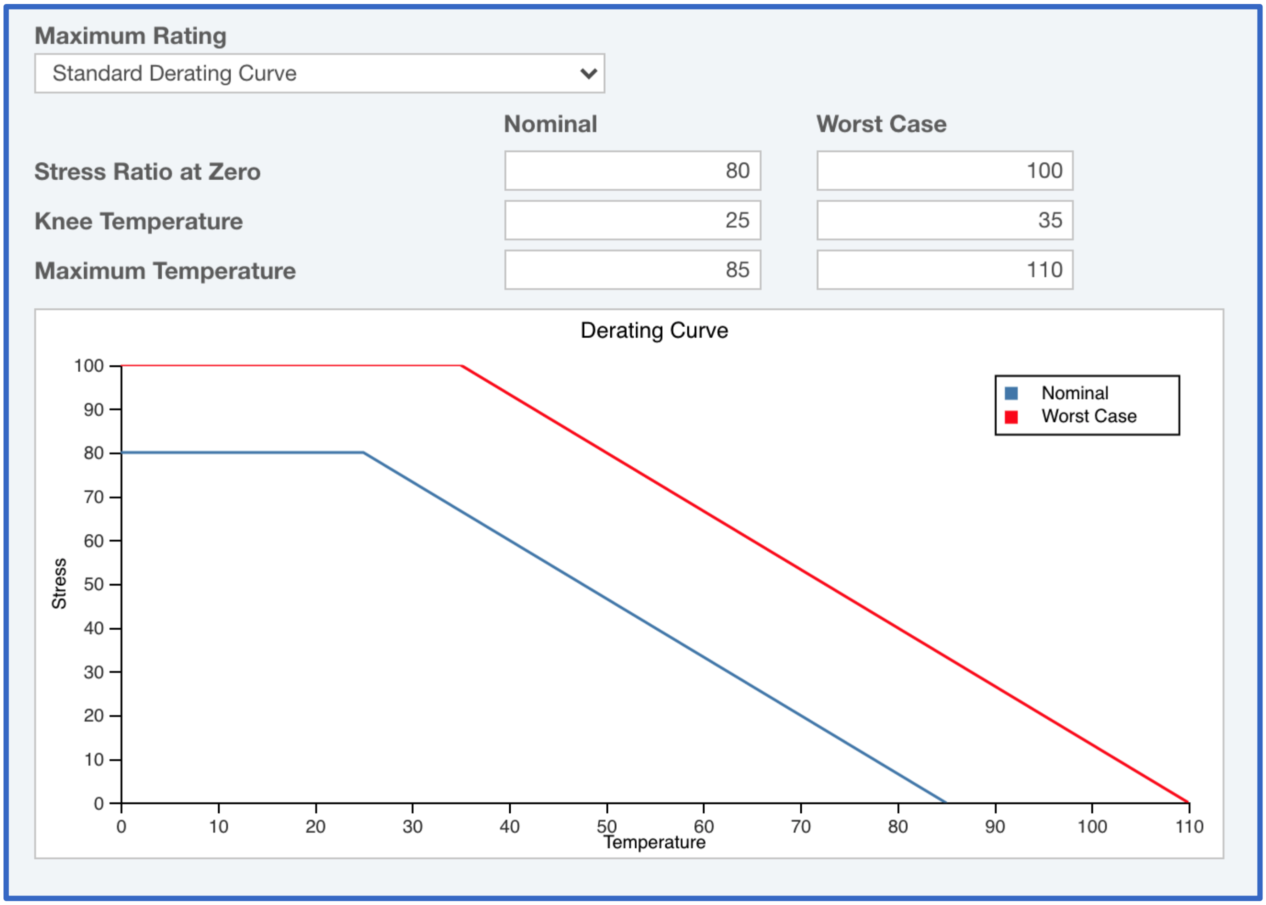
Derating is a means to prolong a component's life by ensuring it operates below its recommended maximum rated capacities. On component data sheets, electronic device manufacturers include maximum ratings for common stresses such as power, current, or voltage. By operating at less than the maximum stresses, devices last longer. This means that failures occur less frequently, and therefore, product reliability is improved.

Part of the information required to perform Reliability Prediction analysis is the operating stresses of the system's components. Combining this available information with the components' derating profiles enables you to perform derating analysis alongside your Reliability Prediction analysis. Derating analysis evaluates the operating stresses components are subjected to and then identifies those that are above acceptable levels.

There are derating standards which are commonly used to perform derating analysis – these include:

- MIL-STD-1547
- MIL-STD-975M
- TE000-AB-GTP-010

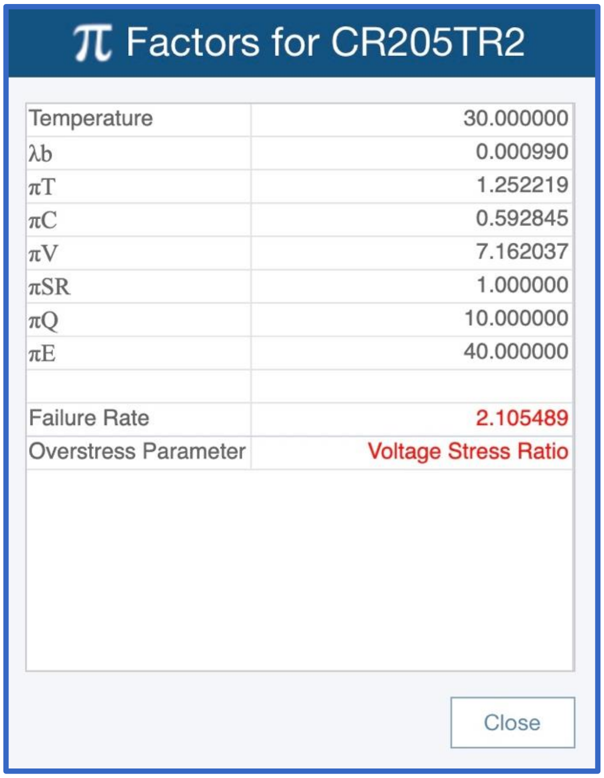
These standards include derating profiles for a wide range of devices. A derating profile defines the stress ranges within which a device should operate. Operating outside the ranges defined in the derating profile results in an overstressed device. The characteristics of a derating profile vary. For example, a derating profile may be a simple value: a specific type of resistor operating over 75% of maximum power is considered overstressed. Or it may be more complicated, as shown in the derating curve profile below. Using the nominal derating curve, the device is overstressed if operating above 80% stress when below 25 degrees. At 25 degrees, the overstress level varies linearly depending on temperature. At 50% stress the device is not overstressed until the temperature is over 50 degrees. It is also common to consider both nominal and worst-case scenarios when performing derating analysis.



Example derating curves for nominal and worst-case overstress conditions for a capacitor.

Relyence Reliability Prediction automatically performs derating analysis during failure rate calculations. Any components exceeding their stress limitations are flagged and appear in red on your tables and reports. Using the Relyence Pi Factors feature, you can view the specific overstress condition for any component in your analysis.

In addition to supporting the commonly used derating standards, you can define your own completely custom derating profiles in Relyence Reliability Prediction.



Specific overstress conditions are noted on the Pi Factors dialog in Relyence Reliability Prediction.

#2: Determine Allocations

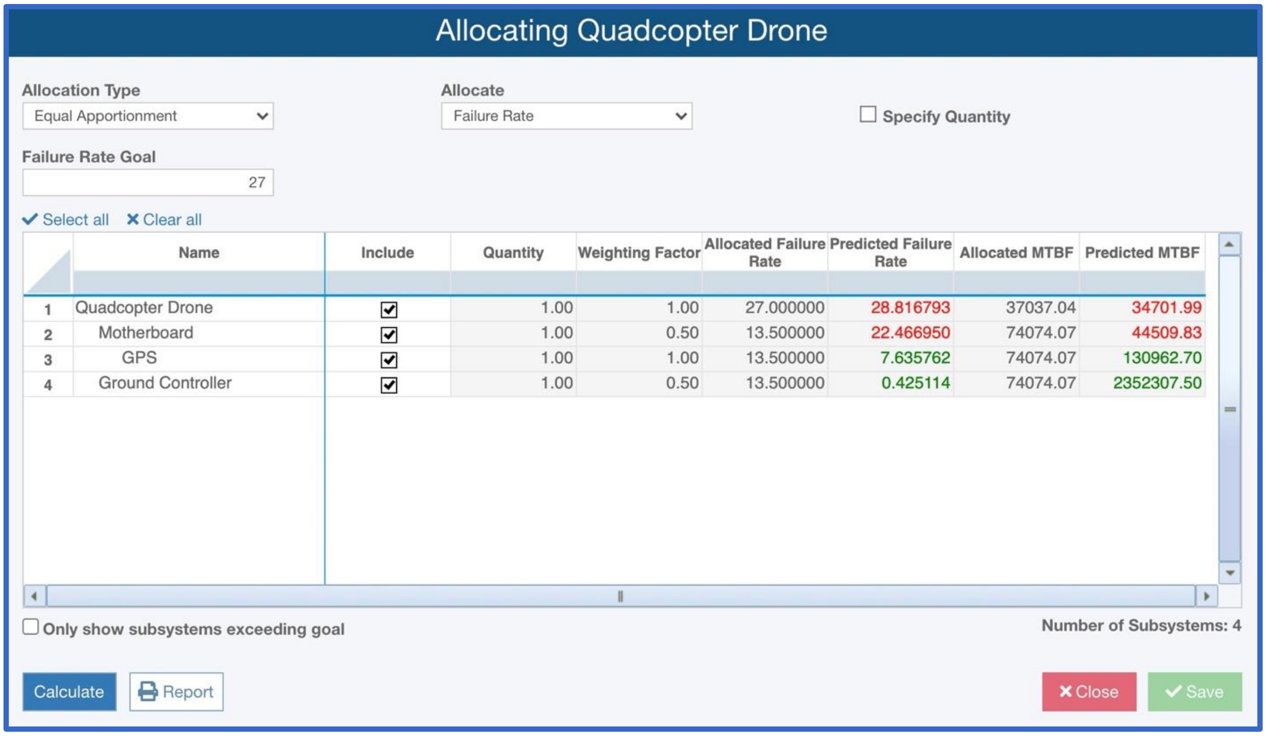
Reliability allocation is a process used to optimally distribute reliability goals across a system in order to meet overall reliability objectives. For example, system integrators may have a specific reliability goal either internally driven or contractually mandated. In this situation, it is important to effectively distribute that goal down to subcontractors and suppliers in a reasonable fashion. By establishing reliability goals for each subcontractor, or each subsystem, a system integrator can be assured that the overall objective will be achieved.

There are several proven allocation methods used to perform reliability allocation analysis. Which you select depends on the data you have as well as your determination as to how best to allocate goals.

Allocation methods use various ways distribute the reliability goal based on *weighting factors*. Weighting factors allow for various measures to influence how much or how little of the overall goal to assign to each subsystem.

Relyence Reliability Prediction supports the following methods for allocation analysis:

- AGREE: The Advisory Group on Reliability of Electronic Equipment (AGREE) developed this allocation method. An *Importance Factor* is used as the basis for the weight factor for Allocation analysis. The Importance Factor accounts for the complexity of each subsystem (based on number of components in the subsystem) and its overall importance to the system.
- ARINC: The *failure rate* of each subsystem is entered and used to determine the weighting factor for Allocation analysis. Typically, the predicted failure rates are used, but specified values can be entered. The allocation goal is distributed across subsystems based on their associated portion of the overall predicted failure rate.
- Equal Apportionment: The goal is distributed equally across all subsystems; therefore, no weight factors are required.
- Feasibility of Objectives: The weight factor for allocation is determined based on 4 rating factors: *Intricacy*, *State of the Art*, *Performance*, and *Environment*.
- Repairable Systems: The availability goal is distributed across all subsystems using *MTTR values* as the weighting factors.
- Weighted: The goal is distributed equally across all subsystems based on the weight factor entered.



	Name	Include	Quantity	Weighting Factor	Allocated Failure Rate	Predicted Failure Rate	Allocated MTBF	Predicted MTBF
1	Quadcopter Drone	☑	1.00	1.00	27.000000	28.816793	37037.04	34701.99
2	Motherboard	☑	1.00	0.50	13.500000	22.466950	74074.07	44509.83
3	GPS	☑	1.00	1.00	13.500000	7.635762	74074.07	130962.70
4	Ground Controller	☑	1.00	0.50	13.500000	0.425114	74074.07	2352307.50

Performing allocation calculations in Relyence Reliability Prediction.

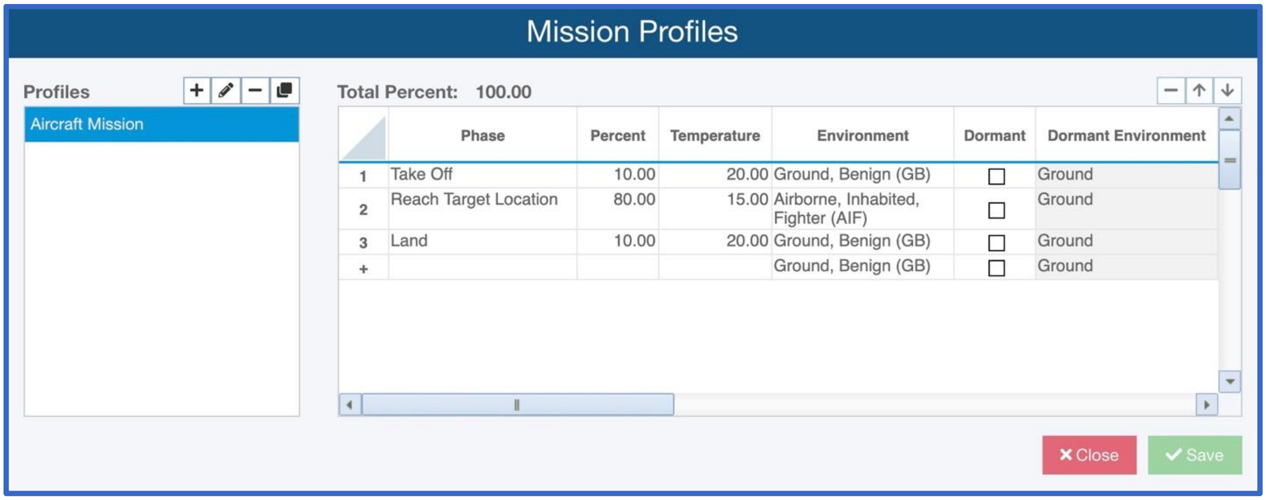
When performing allocation analysis, the results allow you to pinpoint areas where allocation goals are a potential issue. Based on your allocation parameters, the calculation will determine the allocated failure rate for each subassembly in your system. Using the predicted failure rates from your Reliability Prediction analysis, you can view which subassemblies are likely to exceed their allocated failure rate goals. Armed with this knowledge, you can decide on an action plan to maintain your overall reliability objectives. Perhaps you determine a particular subassembly needs some redesign work, or perhaps you decide to change your allocation parameters in order to reallocate failure goals.

#3: Evaluate Mission Success

By default, Reliability Prediction analysis is performed on a system assuming a defined environment and at a defined temperature. In most cases, this is sufficient, especially in cases where a product is used in consistent environmental conditions. However, in some cases you may want to assess performance over more than one operating condition.

One common extension of Reliability Prediction MTBF analysis is to assess mission performance. Mission profiles help to analyze in the situations where multiple environmental conditions are experienced. The fundamental premise of mission profile analysis is to determine the likelihood of mission success, which is critical in many situations. For example, the mission of an aircraft would be to takeoff, reach the target location, and land without failure.

When looking at system performance over a mission, factors that affect reliability vary and need to be accounted for. Some examples of these factors include the environment, temperatures, and stresses. There may even be dormant phases to take into account.



	Phase	Percent	Temperature	Environment	Dormant	Dormant Environment
1	Take Off	10.00	20.00	Ground, Benign (GB)	☐	Ground
2	Reach Target Location	80.00	15.00	Airborne, Inhabited, Fighter (AIF)	☐	Ground
3	Land	10.00	20.00	Ground, Benign (GB)	☐	Ground
+				Ground, Benign (GB)	☐	Ground

Example mission profile for an aircraft.

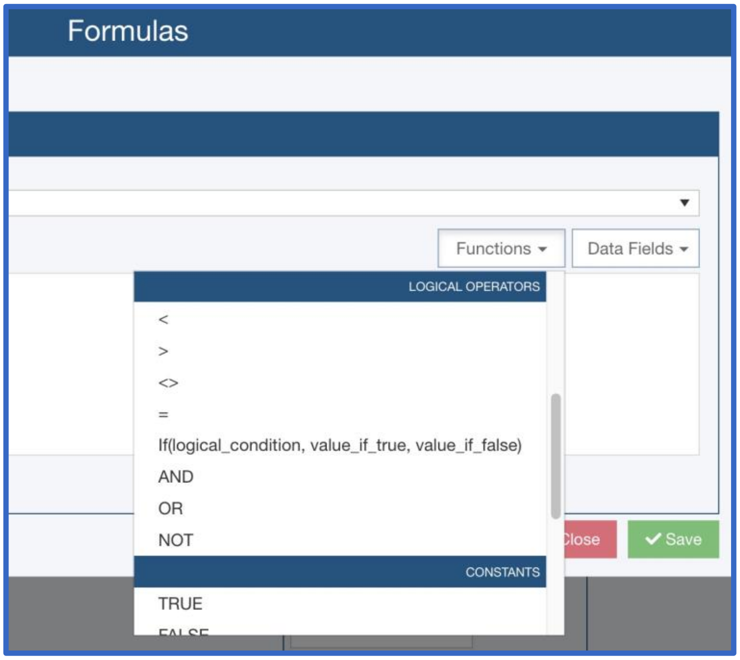
In Reliability Prediction, you can define your Mission Profile, or a listing of the various phases of the mission you want to assess. Using the MTBF equations from the Reliability Prediction standards, the mission-based metrics are computed. The results provided include the predicted failure rate and MTBF for each mission phase as well as the entire mission.

#4: Create and Use Formulas

As with any analysis tool, there are times when you want to extend the analysis to include more than what is provided out-of-the-box. For example, there may be other calculated values you want to see in your Reliability Prediction analyses. Or you may have you own set of metrics your organization wants to track. The Formulas capability in Relyence Reliability Prediction enables you to define you own set of computations to perform using your Reliability Prediction data.

Formulas enable you to harness the power of your collected data. When performing Reliability Prediction analyses, a great deal of data is collected and analyzed in order to calculate predicted failure rates. Given this wealth of information, you can create your own Formulas to compute metrics that may be more helpful for your specific needs or allow for more insight into your design. A common use of Formulas is to adjust predicted failure rates from the standards-based results that align with your field-based experience.

In Relyence Reliability Prediction, you use an intuitive Formula Builder to create your own custom calculations. You can create any number of customized computations using a wide variety of available mathematical functions. Additionally, roll-up and aggregate functions such as SUM (summation) and AVG (average) are available that allow for the computation of cumulative metrics. Also, results from one Formula can be used in another Formula to create even more complex calculations.



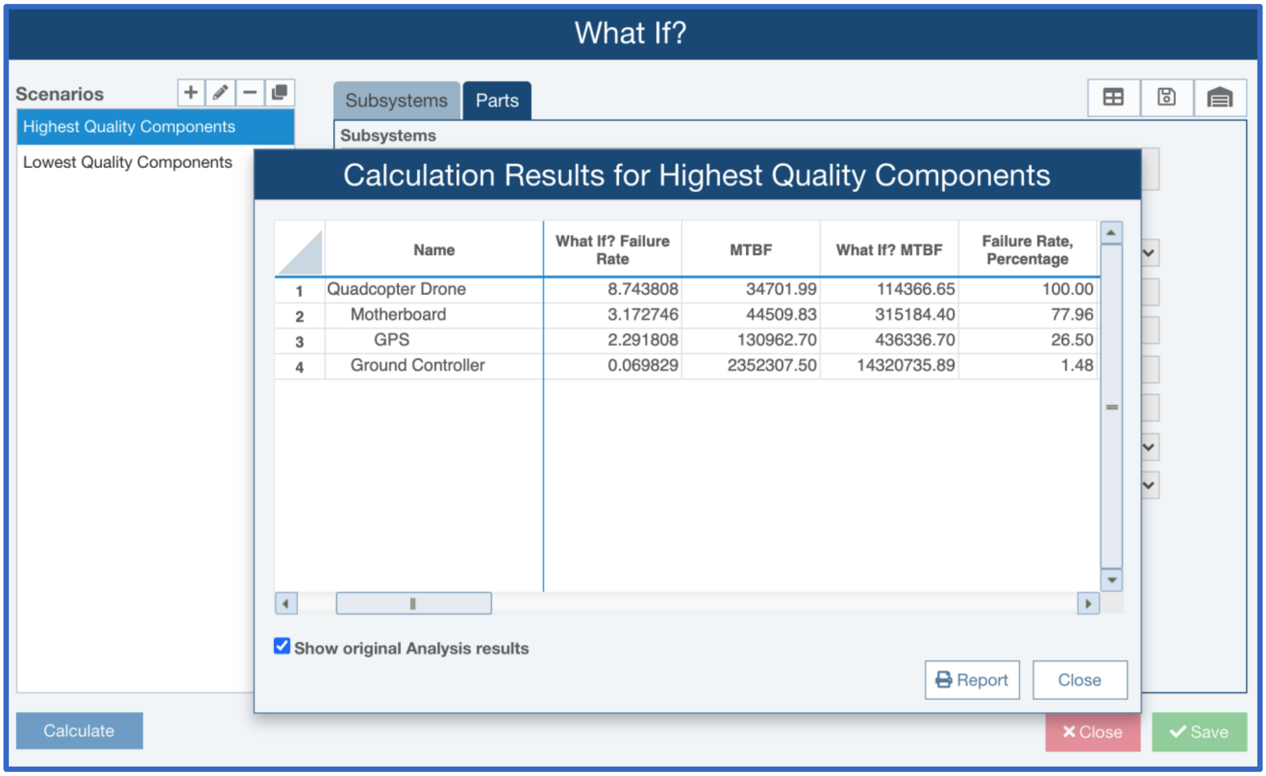
In addition to arithmetic operators and mathematical functions, Formulas also offer logical operations to build complex and useful custom computations.

The power and flexibility provided with Formulas significantly advances your Reliability Prediction analyses beyond the standards-based failure rate and MTBF metrics.

#5: Perform What-If? Trade-off Studies

One of the key benefits of employing Reliability Prediction analysis is to evaluate design alternatives and their effect on product reliability. Therefore, you can use Reliability Prediction to make crucial design decisions early on to ensure the resulting product design will meet your reliability goals. In this light, you can understand why Reliability Predictions can play an especially useful role in early design prior to product manufacturing.

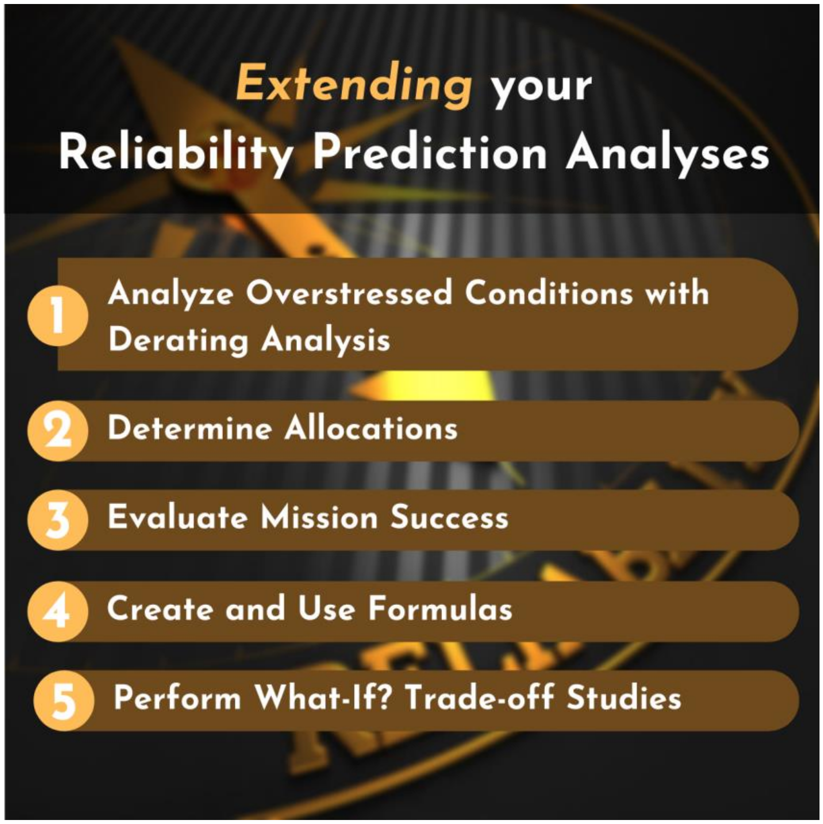
To utilize Reliability Predictions for this purpose, *What-If?* analyses are uniquely helpful. What-If? analyses are a built-in, efficient way to compute MTBF based on different versions of a product design. For example, you may be performing a Reliability Prediction analysis based on a product in the design stage and have calculated the overall system predicted failure rate. At this point you would like to see the impact of procuring certain devices at a different quality level. Perhaps you want to lower the cost by purchasing lower quality parts and want to see how that affects your failure rate. Or maybe you want to improve your product's predicted MTBF, so you want to view the impact of using higher quality components. With What-If? analyses you can make these changes with a few simple clicks and recalculate to view the resulting failure rate values. These results can be used to help guide design reviews and your decision-making process.



What-If? studies can help you evaluate design alternatives.

Relyence Reliability Prediction includes a streamlined What-If? Scenario Editor for quick and easy assessment of trade-off analyses. You can create any number of trade-off studies by changing a variety of data parameters such as temperature, environment, quality level, duty cycle, specified failure rate, and calculation model. The changes can be applied across your entire system, to specified system components, or even at the part level. The flexible interface keeps all your What-If? MTBF calculation analyses organized and on-hand for further review and refinement at any time during the design process.

In addition, the Relyence Reliability Prediction Dashboard includes a What-If? widget. This visual view of your What-If? scenario metrics provides an impressively powerful way to see the effects that various design decisions have on product reliability.



Leveraging Reliability Prediction Data

We have looked at ways that allow you to perform your Reliability Prediction analyses more efficiently and extend analysis beyond the assessment of failure rate values. Another advantage of Reliability Predictions is the ability to leverage your Reliability Prediction data in other aspects of your reliability platform. In this way, Reliability Prediction becomes an important component of your reliability toolset.

#1: Integrate with other Reliability Tools

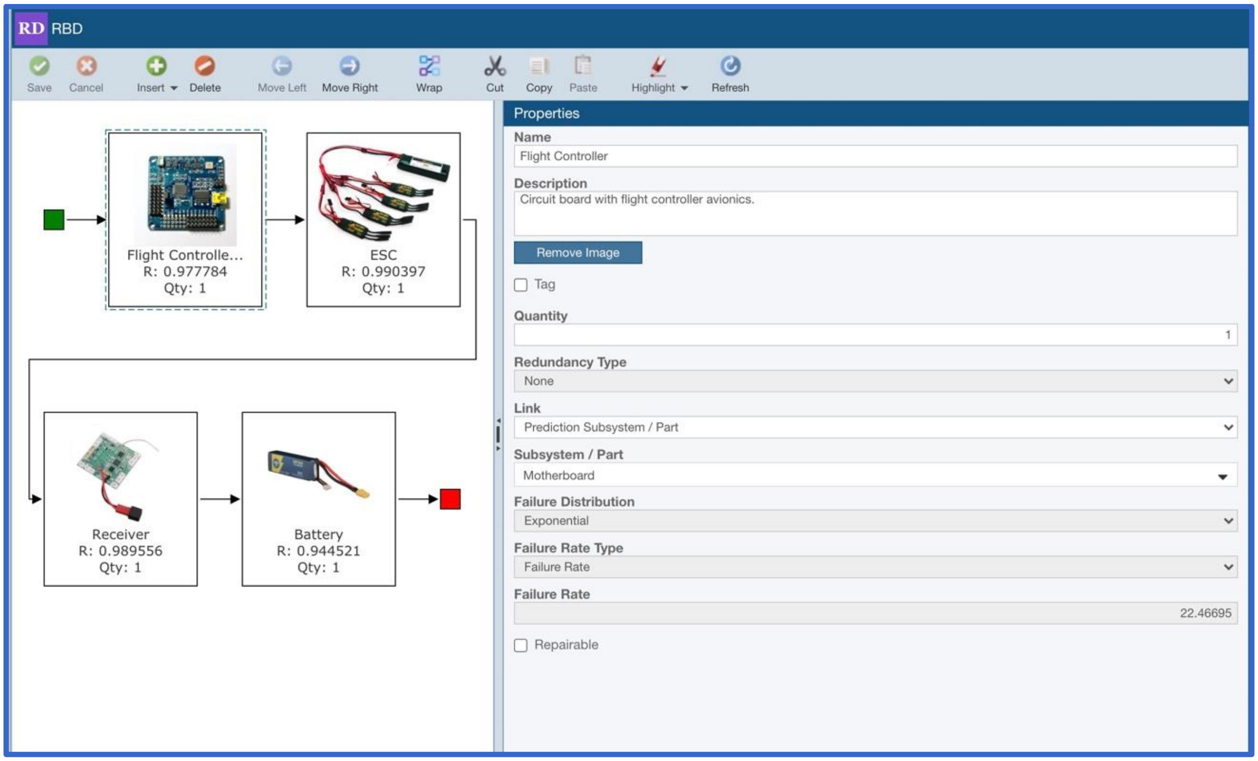
Reliability Prediction data can be utilized in your other reliability analysis tools. This data sharing means your overall analysis platform is more cohesive and offers greater efficiency and productivity. Because different analysis techniques are often performed by different teams, this integration allows your team to work together and recognize how everyone is invested in the same overall reliability goals.

Reliability Prediction and RBD

Reliability Prediction analyses are oftentimes coupled with Reliability Block Diagram (RBD) analyses to allow for a broader, more complete system profile. In Reliability Prediction analysis, it is assumed that all subassemblies are connected in series. However, your overall system model may include branches to connect subsystems in a variety of ways or may include redundant components.

Redundancy is employed in system design to ensure that when a component or path fails, a secondary component to path can take over to keep the system operational. One of the main benefits of RBD analysis is that it allows you to perform reliability and availability calculations for systems that include redundant components.

In cases where your system design extends beyond a simple series configuration, RBD analysis can be key for full system performance analysis. In these situations, Reliability Prediction and RBD often go hand in hand. Using the two together enables you to perform complete reliability and availability analyses on your system.



Use Reliability Prediction together with RBD for a powerful reliability analysis platform.

To use the two tools together, you can use the failure information from your Reliability Prediction analysis when creating your system model in RBD. In this way, your analyses are tied together. If you make design changes which impact the failure rate data computed in Reliability Prediction, those changes will automatically be taken into account in your RBD analysis.

The Reliability Prediction-RBD duo provides a superior approach for comprehensive system modeling.

Reliability Prediction and FMECA

FMECA, or Failure Mode, Effects and Criticality Analysis is a highly detailed type of FMEA (Failure Mode and Effects Analysis). FMECAs incorporate the calculation of criticality values down to the piece-part level. Failure rate values are used to perform this criticality evaluation. The most efficient way to obtain failure rate data required in FMECAs is by using the values obtained from Reliability Prediction analysis. For this reason, FMECAs are often coupled with Reliability Prediction.

FMECAs typically follow the methodology defined in MIL-STD-1629A. Oftentimes, these FMECAs are done in conjunction with MIL-HDBK-217 Reliability Prediction analyses. The origin of both these standards is the US Department of Defense, so military applications often use these analyses together. However, due to the wide acceptance of these standards, other industries have also adopted this approach for comprehensive failure analysis.

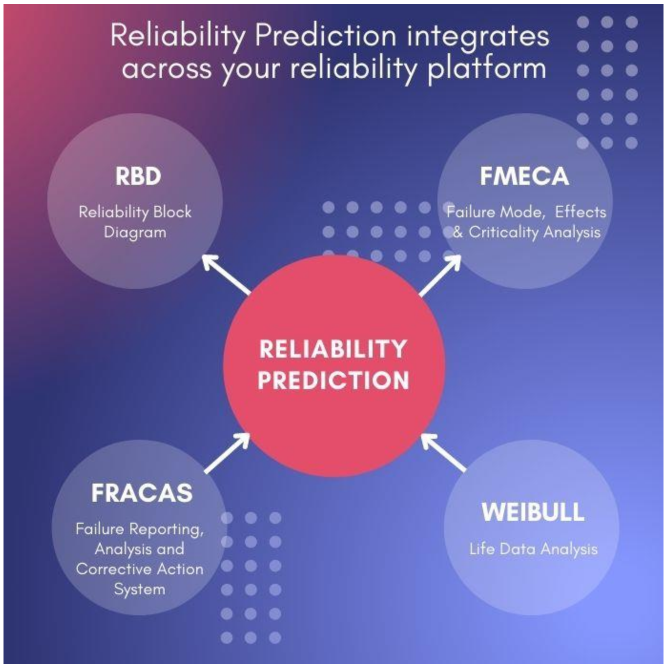
When using both Relyence Reliability Prediction and Relyence FMECA, failure rate values are automatically shared to streamline data handling and provide a seamless integration between your analysis tools.

Weibull Analysis and Reliability Prediction

Reliability Prediction analyses provide predicted failure rate values. These values are derived from the statistical analysis of a large quantity of data over a long period of time which resulted in the equations in the various Reliability Prediction standards. These models are therefore based on probabilities as determined from historical data.

In contrast, [Weibull Analysis] techniques are employed to perform a similar type of probabilistic assessment based on real world accumulated data. When using Weibull Analysis, you enter data acquired during actual product use, such as failure times, number of failures, and number of non-failures. Weibull Analysis incorporates a number of statistical techniques based on distribution analysis to curve fit the data provided in order to evaluate data trends and product performance.

You can combine these two techniques to incorporate your Weibull-based analyses in with your Reliability Prediction analyses. In Relyence Reliability Prediction, you can directly link data from Relyence Weibull to components in your Reliability Prediction analyses. The incorporation of this field-based data into your Reliability Prediction analyses offers even greater confidence in your reliability assessments.



FRACAS and Reliability Prediction

FRACAS, or Failure Reporting, Analysis, and Corrective Action System, is a management system for handling issues that arise with products or processes. FRACAS falls under the broad umbrella of Corrective and Preventive Action (CAPA) processes which provide a framework for the effective handling of any type of failure, complaint, incident, issue, problem, or concern. The main benefit of CAPA and

FRACAS is the assurance that as incidents arise, they are captured and tracked until properly addressed, or "closed out" in CAPA terminology.

Because FRACAS captures real world data such as product failures and repairs, there is a wealth of information available. Similar to Weibull, the real-world data from your FRACAS can be integrated into your Reliability Prediction analyses.

Using Relyence, this is a two-step process involving three products of Relyence Reliability Studio. From Relyence FRACAS you can create a Weibull Data Set based on accumulated failure data. As described above, this Weibull Data Set can then be linked to your Reliability Prediction analysis. The ability to combine predictive measures of Reliability Prediction with real-world metrics from FRACAS provides a more finely tuned evaluation of product performance.

#2: Create Dashboards for Overview and Insight

The results of Reliability Prediction analyses are most commonly a list of failure related metrics, such as failure rate and MTBF. Though these resulting metrics can be viewed on screen and in a variety of reports, this may not provide the clearest and most concise way to interpret the data. This is where *dashboards* play an important role for quality data analysis.

In general, dashboards are a way to accumulate a variety of data into a cohesive visual presentation. The most common dashboards we encounter are in our cars. They allow us to quickly review all the most important information at a glance. In the same way, dashboards are used in software applications in order to present vital information in an easy-to-read overview.

The Relyence Reliability Prediction Dashboard gathers and organizes your data to provide a holistic overview of your product or system. As one example, you can use the Relyence Reliability Prediction Dashboard to view all overstressed components in your design.

While the Relyence Reliability Prediction Dashboard provides a high-level overview, the underlying data is always available at your fingertips with the click of your mouse. The Relyence Reliability Prediction Dashboard's drilldown feature takes you from a chart, table, or graph directly to the corresponding analysis information. For example, perhaps you want to delve into the details about the component in your system with the highest failure rate. By clicking that part on the dashboard, the

Reliability Prediction analysis will automatically be opened, and you will be taken to the part in question where you can view detailed data such as operating temperature, stress, etc.

Dashboards provide an efficient and organized high-level overview of performance metrics.

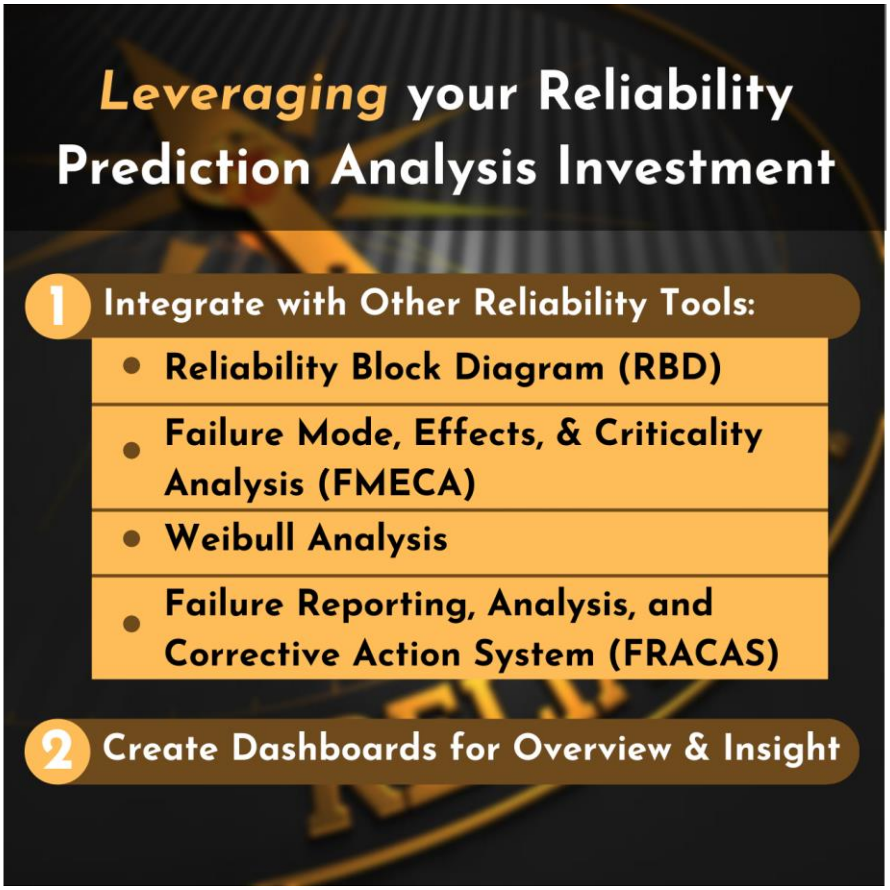
Dashboards are customizable, so you can select the elements which are most useful for your requirements. Additionally, with Relyence Dashboards, you can mix results across various products for even greater flexibility and insight. For example, you can view results from Reliability Prediction analyses alongside results from RBD analyses on the same Dashboard.

Some of the elements that are available on a Relyence Reliability Prediction Dashboard include:

- Failure Rate Percentage - a pie chart showing the failure rate percentage of each subsystem in your system.
- Failure Rate vs Temperature - a line chart of failure rate values over a specified range of temperatures.

- Overstressed Parts - a listing of overstressed parts.
- Parts Contributing 80% of Failure Rate - bar chart showing the parts whose failure rates contribute to 80% of the overall failure rate.
- Top (N) Failure Rate Parts - a bar chart of the parts with the (N) number highest or lowest failure rate values.
- What-If? - a bar graph of showing a comparison of failure rates of specified What-If? scenarios.

The Relyence Reliability Prediction Dashboard is useful for any or all team members such as high-level managers, analysts, engineers, and designers. As with all well-designed dashboards, the Relyence Reliability Prediction Dashboard allows team leaders as well as contributors to gather and react to information in real-time to keep quality and reliability objectives on track.



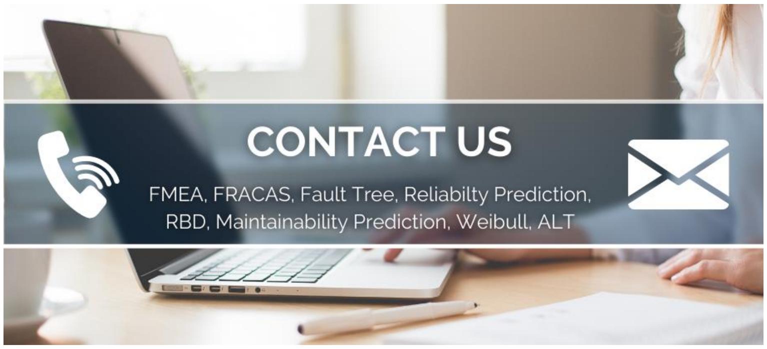
Conclusion

Oftentimes, engineers approach Reliability Prediction as a singular tool used to provide failure rate assessments of electromechanical systems. And often they view the Reliability Prediction process as time-consuming and cumbersome. Both are misconceptions that can be easily dispelled by taking a more in-depth look as we've done in this article. Your investment in Reliability Prediction analysis can be leveraged in a variety of ways to advance and enhance your continuous improvement efforts.

First, there are numerous ways to improve data entry efficiency while at the same time improving analysis effectiveness, such as utilizing Parts Count when applicable, using default values and Intelligent Part Mapping, taking advantage of device libraries including NPRD and EPRD databases, and leveraging the power of Knowledge Banks.

Secondly, you can extend your analyses for further gains based on your initial investment in Reliability Prediction analysis by using advanced techniques including derating analysis, allocations, formulas, mission profile analysis, and What-If? studies.

Lastly, leverage Reliability Prediction as part of your complete reliability analysis toolset with the use of Dashboards for helping design decisions and integrations across your other reliability tools for accurate system performance assessments.



At Relyence our mission is not only to create the best-in-class toolset, but also to offer a robustness and design elegance above and beyond expectations for analytical software tools. We believe we've achieved our objectives with Relyence Reliability Prediction. We hope that you take the opportunity to give us a free trial test run. See Relyence in action for yourself or allow us to guide your through a personalized demo on your schedule or feel free to contact us.