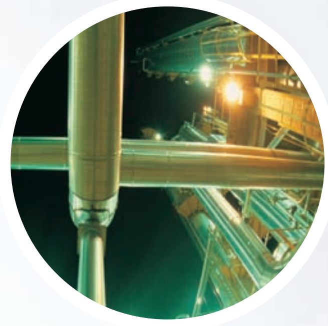
Reliability and Risk Solutions



Quantitative Risk Assessment
Reliability
Availability
Maintainability
Safety

Software Tools and Support
Training and Consulting

item Software

World Leaders In Reliability And Safety Analysis Software

Welcome

Since 1986, thousands of reliability and safety professionals in a wide range of industries have relied upon ITEM Software to meet the challenge to analyse their product's reliability, safety and risk.

ITEM Software is proud to offer you a complete solution of software and services that are entirely focused on your needs. As your requirements become more diverse, we continue to enhance our solutions and services to maintain the trust that you have placed in our company.

"Your guaranteed satisfaction" is our pledge. We do our best to meet your ever-changing requirements. Your feedback over the years is what has encouraged ITEM Software to enthusiastically accept the challenge, and deliver satisfactory solutions.

Over the past few years, many of you have noticed the addition of new dynamic features to our tools. Based on your valuable feedback and suggestions, we have introduced many new ideas, enhancements, features and innovative ways to help you meet your project requirements.

We are grateful for your response and acknowledgement of our ongoing efforts, and value your trust in delivering innovative solutions to your needs.

With our best wishes,

ITEM Software

Contents

ITEM Technical Services

Technical Support

The mission of the ITEM Technical Services Group is to be an extension of your engineering team. Not only are we available to assist you with using our software, but we can also help you through the reliability, safety and risk modelling processes, start to finish. Whether via telephone, email, instant messenger or webinars, our staff of experienced and interested engineers will go the extra mile to ensure you get the answers you need. With offices in the USA and UK, we easily cover your worldwide support needs.

Consulting

Are you:

- Starting a new reliability, safety, or risk assessment project?
- Trying to complete an existing one?
- In need of validating your analysis results with an outside view?
- Not sure where to start with your process, system, or components?

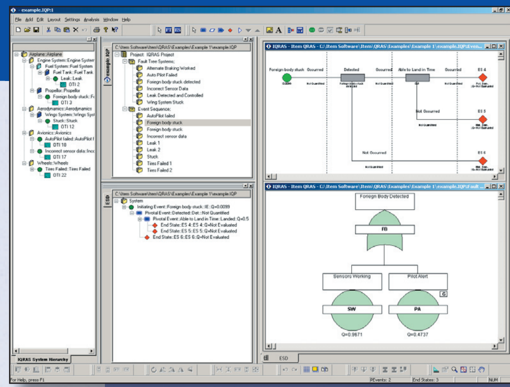
Count on ITEM Software when you need extra help. For years ITEM Software has provided more than just Reliability and Risk Assessment software tools to companies large and small. Our Reliability, Availability, Maintainability, Safety and Risk Assessment engineers can provide consulting services to assist you in conducting your analyses. Our experienced, and worldwide, staff are able to help you with any size project or analysis: across nearly any industry. We can work with you on your Reliability and Risk analysis projects from beginning to end, under strict confidentiality.

Our approach to consulting is to deliver the most complete and accurate results and analysis; including your team as much, or as little, as you wish in the process. We gladly deliver, discuss and defend all results, project files and knowledge gained during and after the project. We consider ourselves an extension of your team, delivering on task and on schedule.

Training

Come and learn the methodologies behind the tools from experts in the field. Our instructors have many years of reliability and safety engineering experience in a variety of industries, government and academia. Not only will you learn the foundation of the techniques, but you will also benefit from real world examples presented in class. The instructor will guide the class through lecture and question and answer periods, as well as lively discussions where you can learn from the experience of others in the class. We also offer any of our classes or workshops onsite and customized to suit your needs, worldwide. Please contact us directly for more details.

ITEM QRAS



Quantitative Risk Assessment

Understanding risk and having the right strategies in place, when an incident occurs, is becoming more evident and essential. More and more, organizations are faced with the need to measure and reduce their risks.

A successful and effective approach to risk management critically depends on the ability to answer key questions:

- How large are our risks?
- What are the most likely risk scenarios, and how severe would the consequences be?
- What elements in our system or organization are the major contributors to risk?
- How will our risk be affected by changes to the system or organization?
- How confident are we about the answers to the above, and how can we increase our confidence?

Do you have to analyse multiple or single factors to address the uncertainties when reducing your risk?

Do you consider such factors as systems, processes, organization, people, communication and unforeseen elements as part of your risk assessments?

Do you need to construct scenarios with many elements or factors during your risk assessment?

Do you consider elements that could adversely effect your organization's mission, proposal, production, finances, design, acquisition, schedule, requirements and management?

Do these elements or factors pose a threat or potential risk on their own, or have an effect on other parts of the organization?

ITEM Quantitative Risk Assessment System (iQRAS) can help identify the risks, find the major contributors, effective ways to reduce the risks, and improve your understanding. The initiating event integration with time lines, event sequences, failure probability characterization, risk ranking, and sensitivity analysis, provides you with a powerful, integrated, risk analysis environment. Other Probabilistic Risk Assessment (PRA) tools cannot match the unique integration of capabilities in iQRAS.

• Scenario-Based Risk Modelling

• Event Sequence Diagrams

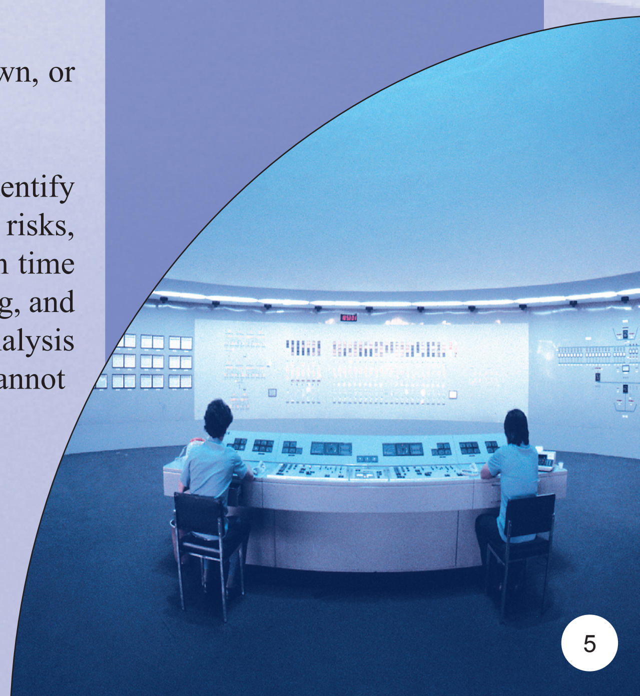
• Fault Trees

• Risk Level Quantification

• Risk Contributor Ranking

• System Level Risk Aggregation

• Binary Decision Diagrams



ITEM QRAS

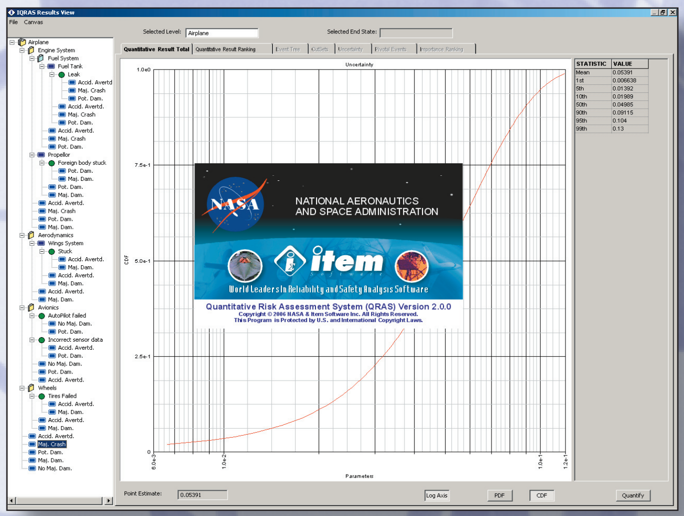
What is iQRAS

iQRAS is a user friendly software tool with a fully integrated environment for constructing and analysing risk models. A powerful aid for conducting PRA, you can construct and quantify risk scenario models, estimate numerical risk levels, and identify major risk contributors.

Although initially developed for NASA, the features of iQRAS allow it to be applied to a wide range of applications, including aerospace, military, transportation, as well as medical procedures. iQRAS was designed to be used by a wide range of engineers and analysts. It is suitable for use by safety engineers who are seeking to enhance their safety analyses.

iQRAS is the latest addition to ITEM Software's suite of risk and reliability software tools. The latest version of the software completes the transformation from the original software, as developed by the University of Maryland and NASA. The new environment provides an extensive set of editing and reporting capabilities, in line with those found in ITEM ToolKit: our flagship suite of tools for reliability, availability, maintainability and safety analysis.

On the computational side, iQRAS offers state-of-the-art algorithms that are both highly efficient and, unlike conventional solution methods used in most other tools, are not subject to often significant approximation errors.



Modelling and Analysis Capabilities

With iQRAS you can develop risk models in the form of event sequence diagrams and fault tree models. Event Sequence Diagrams (ESDs) describe the possible risk scenarios following potential perturbations of normal system operations. Pivotal events in the risk scenarios are further detailed using fault tree models or other distributions. This defines the occurrence of those pivotal events as logical combinations of one or more basic events. Each scenario eventually leads to an end-state and consequence that designates the severity of the outcome of the particular scenario.

The Event Sequence Diagrams are organized using a system hierarchy, consisting of structural or functional decomposition. A mission timeline allows the break down of the overall mission into multiple mission phases. This organizing capability makes for easy navigation between the potentially large numbers of event sequence diagram models, and tailors the risk scenarios to the particular conditions of a mission phase.

A wide variety of quantification models are available to specify the likelihood of occurrence of basic events. These include standard demand-based and time-based reliability models, as well as highly customizable models that take advantage of the optional link with Mathematica®.

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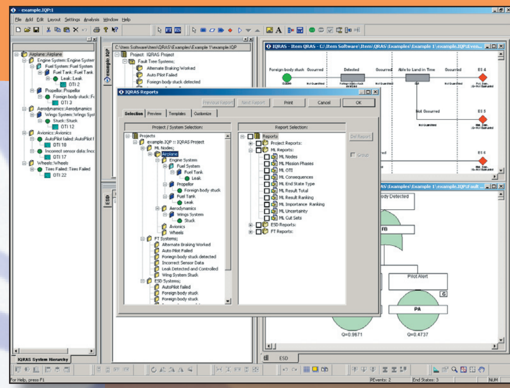
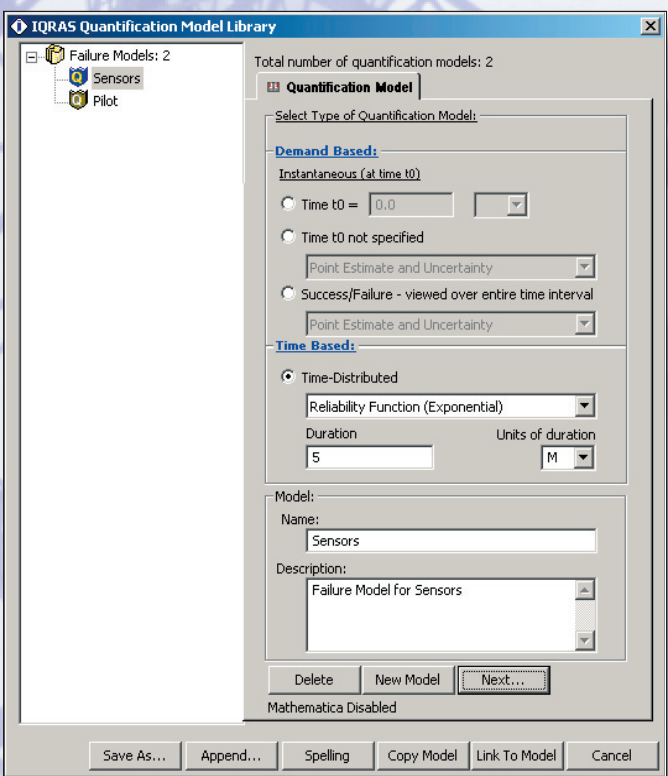


Additionally, iQRAS contains a centralized common cause failure-modelling feature. This enables common cause failure effects to be introduced across multiple fault trees. This feature significantly reduces the burden of introducing and maintaining common cause failure events in a model.

Parameters in all models are specified by means of uncertainty distributions. These can be formed by common parametric models such as the lognormal, uniform, gamma, beta distributions, and probability histograms. For each distribution, iQRAS contains flexible input modes that allow the parameters of the distribution to suit the needs of the analysis.



Risk results can be obtained at the fault tree, risk scenario or end state level. They can also be aggregated over multiple event sequence diagrams associated with a specific portion of the system hierarchy and/or a portion of the mission timeline. Analysis features include the estimation of total probability of reaching specific (undesirable) end states; the ranking of risk scenarios or risk scenario initiators by total risk contribution; cut-set analysis for the identification and ranking of critical combinations of events, leading to a particular end state or consequence; and the computation of importance measures indicating the impact of individual basic events on the overall risk.

iQRAS employs state-of-the-art Binary Decision Diagram based analysis techniques which are not subject to approximation errors, found in traditional analysis techniques. Studies have shown these errors may span orders of magnitude. Monte Carlo (Latin Hypercube) Sampling, including based uncertainty propagation techniques, are used to determine the uncertainty surrounding numerical results. Separate importance measures are provided to identify the events contributing the most to overall uncertainty.

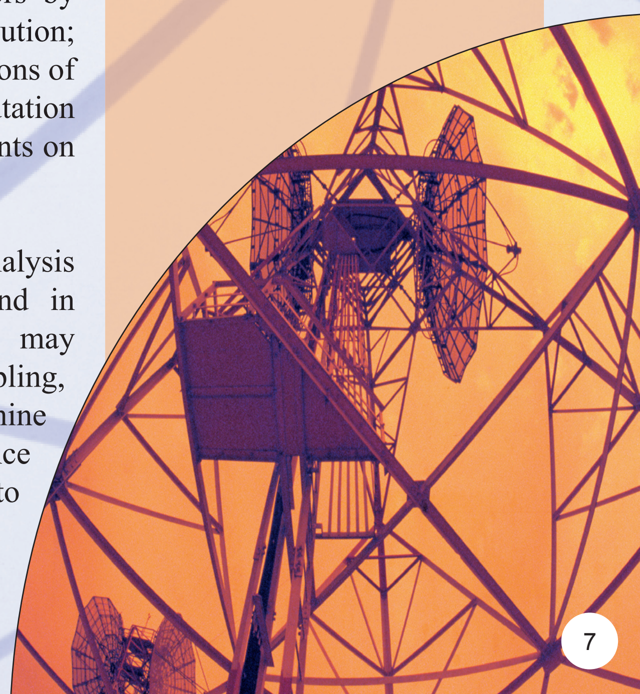
• User friendly risk modelling tool

• Extensive printing and report generation capabilities

• Powerful and accurate algorithms for risk quantification and contribution ranking

• Flexible graphical editing capabilities for event sequence diagrams and fault trees

• Converts CAFTA® models automatically



ITEM QRAS

iQRAS Major Features

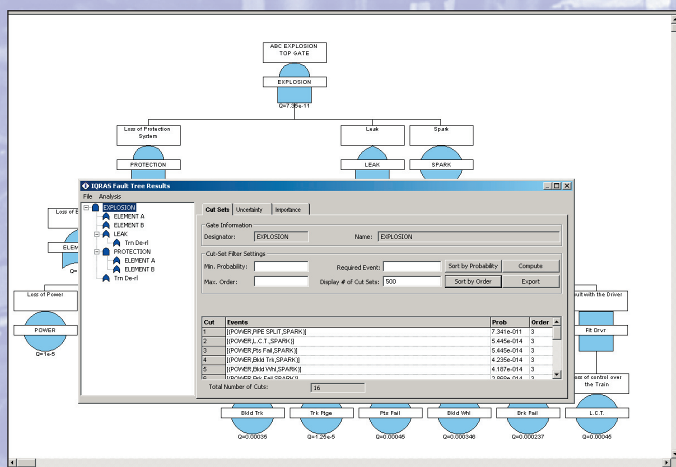
Risk Model Analysis

- Exact results generated by Binary Decision Diagram (BDD) based solution methods
- Computation of cut-sets, risk importance measures and probabilities for fault trees and ESDs
- Uncertainty propagation and uncertainty importance measures
- Risk aggregation over event sequence diagrams, end state types, and system or functional hierarchy

Organization of Risk Models

- Organization of ESD models by user-defined system or function hierarchy
- Organization of ESD models by mission phases and operational time intervals
- Easy navigation between the ESDs and fault trees

Common Cause Failure Modelling



- Centralized definition of common cause failure event groups
- Automated application of common cause failure expansions to selected fault tree models
- Support for Alpha and Beta Factor models
- Common cause failure expansions within and across fault trees

Quantification Models

- Extensive set of time-dependent and demand based component reliability models
- Easy-to-use specification of uncertainty distributions for model parameters
- Mathmatica® (not included)

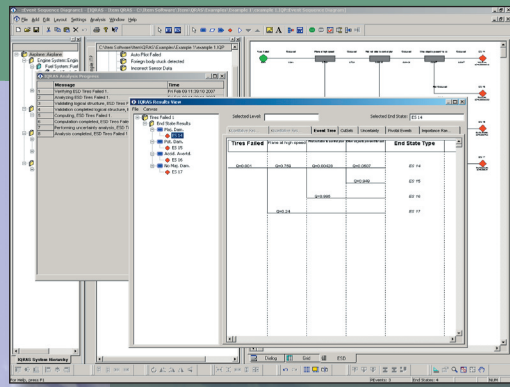
Incorporation of Other Models

- ITEM ToolKit

Event Sequence Diagram Quantification

- Quantification of ESDs using the fault tree list created in the fault tree editor
- View and attach fault trees from the pivotal/initiating event quantification dialogs
- Fault tree editor can be opened and used independently to create and quantify the fault trees
- User can change ESD events designators

ITEM QRAS



Gate ESD Detail Results

- User defined number of cut sets that iQRAS will calculate based on probability. iQRAS can also display the actual number of cut sets for the analysed system. For example: the advanced BDD algorithm could calculate the top 500 cut sets, even if the actual cuts were more than a billion, within seconds
- Users can get detailed uncertainty results for any gate

Reporting, Export of Risk Models and Results

- Export of models and results to Microsoft® Word, Excel and Access
- Extensive reporting capabilities using Crystal Reports™

iQRAS Feature Highlights

Event Sequence Diagram Editing

- User-defined end state types and consequences
- Support for scenario transfer points
- Maximum flexibility to modify visual appearance of diagrams
- Auto pagination and auto arranging
- Copy and paste entire, or only segments of, the ESD

Versatile Fault Tree Construction

The foundation for building a fault tree is the versatile user interface within iQRAS. It is capable of creating fault trees via a hierarchy mechanism, or a traditional fault tree diagram. The fault tree diagramming mechanism is a feature rich, fully customizable, diagramming tool.

- Build fault trees in the traditional way by adding gates and events in the diagram
- Build fault trees using a hierarchical view, by adding gates and events to hierarchy nodes
- Fault tree diagram and hierarchy are automatically kept synchronized
- Change sizes and colours of gates and events, fonts, labels and text boxes
- Add text, header and footer information directly to diagrams

Fault Tree Editing

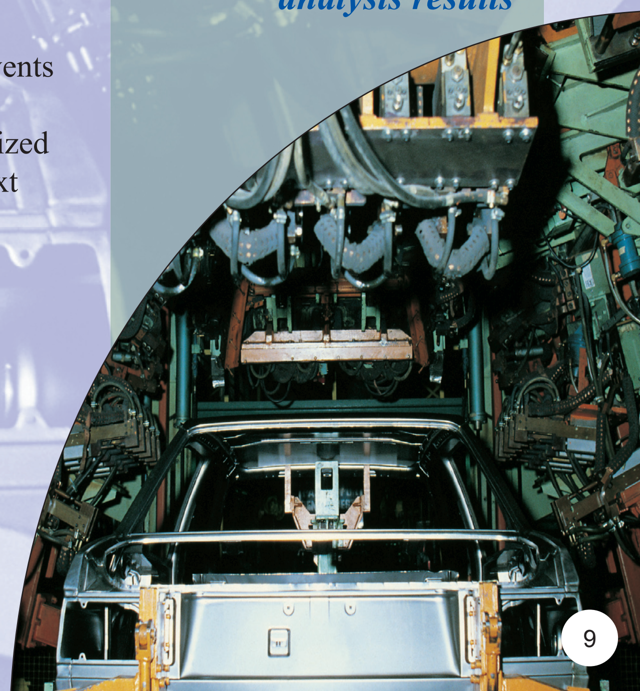
- Unavailability and uncertainty calculations
- Full set of logic gates and event types

• Single integrated environment for risk model construction and analysis

• Import and export gates, events and ESD parameters in formats such as MS Excel® and Access®

• Simultaneously display fault tree and ESD results on the diagram

• Simultaneously create and open multiple fault tree projects, and compare analysis results

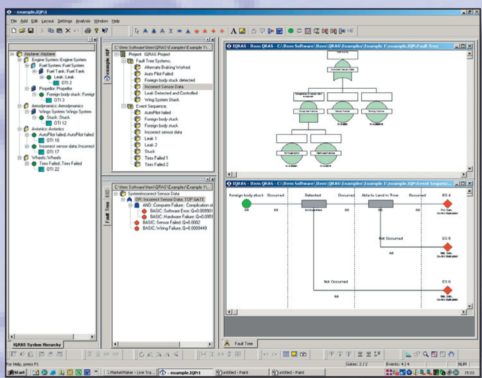


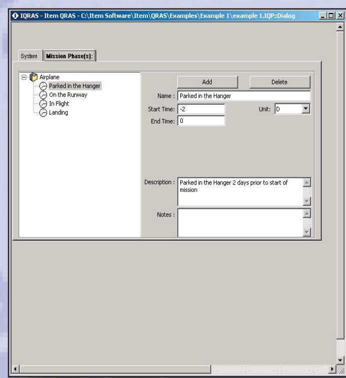
ITEM QRAS

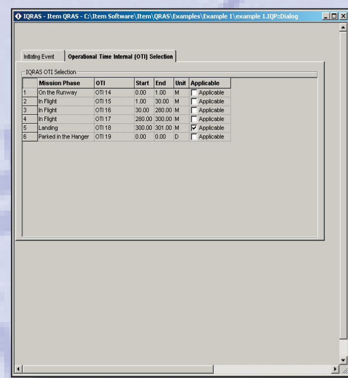
- Re-use of fault tree models across multiple event sequence diagrams
- Standard visualization as well as condensed tree-views
- Maximum flexibility to modify visual appearance of diagrams
- Hierarchical and tree views of fault tree
- Auto pagination and auto arranging

Fault Tree Linking

- Link fault tree logic to other fault trees or gates. Create fault trees in smaller, more manageable, pieces







Multiple Projects: Fault Trees & Event Sequence Diagram

- Effortlessly creates, reviews and analyses multiple fault trees and ESDs simultaneously
- Merge all or a portion of a fault tree to create a master fault tree
- Manage fault trees from multiple projects
- Allow creation of a fault tree by reusing all, or a portion, of an existing project
- Copy and paste gates and events between projects and fault trees

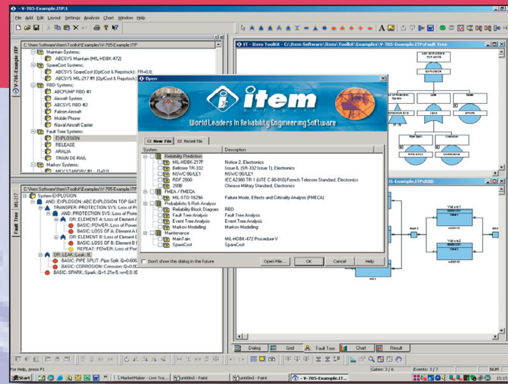
Auto-Arrange and Auto-Paginate

- Automatically arranges all gates and events in the fault tree following user-defined settings
- Automatically paginates fault trees according to user defined page settings. Transfer gates are added at appropriate places, dividing the tree into multiple pages

MS Word Transfer

- Automatically transfer fault tree diagrams into Microsoft® Word documents

ITEM ToolKit



Fully Integrated Reliability and Safety Analysis Software Program

ITEM ToolKit is a suite of comprehensive prediction and analytical modules all in an integrated environment. ToolKit is an integrated environment benefiting from object-oriented architecture; delivering accuracy, flexibility and ease of use. It offers you convenient features that provide a consistent format for all your analyses. This enables *learning carry-over* from one module to another.

ITEM ToolKit has standardized many critical functions, shortcuts, and other features that operate identically in each module. This saves you time and effort, increasing your productivity. Whether you are starting a new analysis, or using different modules, the essential functions remain the same. In addition to the standard features, each module functions independently, (or linked with others), having its own unique features and functionality.

ITEM ToolKit uses globally recognized standards and methodologies to analyse components, systems and projects. It allows you to take a total system approach in analysing individual systems and components. This allows you to optimize your design targets with respect to component selection, increased safety and reduced liability.

No other tool offers the diverse User Interface like that of ITEM ToolKit's. You can create and analyse multiple systems and projects at the same time. You can share project files and libraries with other engineers or departments.

- Build and open multiple systems and project files
- Build several systems at the same time and compare analysis results
- Drag and drop components and systems between projects
- Create a new project quickly by re-using components from other projects or libraries

You can analyse Reliability, Availability, Maintainability, Safety and Risk of components or systems and view the entire project.

Flexible, Easy-to-Use Interface for Viewing and Editing

An easy-to-use User Interface makes it faster and easier to manoeuvre throughout your project or system. You can view your Project or System information in a tabular grid, dialog box, hierarchy tree, chart or graph. You can also control the size and position of any window with standard Windows® functions.

Included Modules

- ***Reliability Prediction:***
  MIL-HDBK-217
  Bellcore / Telecordia
  IEC 62380 (RDF)
  IEC 61709
  China 299B
  NSWC
- ***FMECA***
- ***Reliability Block Diagram (RBD)***
- ***Fault Tree Analysis***
- ***Event Tree Analysis***
- ***Markov Analysis***
- ***Maintainability***
- ***Spare Scaling & Ranging***

ITEM ToolKit

New project or system data can be added via the hierarchy tree, dialog box or in tabular grid. Editing is as simple as a click on any of the standard options such as cut, copy, paste, and drag and drop.

Advanced Grid / Tabular View

You can add, edit and display the system information and structure in a grid, or "spreadsheet", view. Using filters and adding additional columns, you can customize this view to represent your system as you wish. Use this table as a report by simply dragging the table to Microsoft® Excel, and share your analysis information with others.

Powerful Chart and Graph Wizard

ITEM ToolKit offers a wide variety of charts and graphs for viewing systems and project data in a graph / chart format. You can choose to generate the charts automatically within ITEM ToolKit, or by using the Chart Wizard and Edit Graph functions, generating custom style charts. You can also save chart displays as image files for use in reports and presentations.

User Defined Custom Libraries

Analyse your system once and create multiple custom libraries containing components and block information, failure modes, cause and effects, events and fault trees. ITEM ToolKit allows you to create and use multiple libraries at the same time. This time saving feature will shorten the time for constructing new systems. The analysed components, events or blocks can simply be added to a new system by using the drag and drop or copy and paste feature. Data can also be imported into ITEM ToolKit projects as well as libraries.

Import/Export Facilities

With ITEM ToolKit's user-defined powerful import and export facility, you can easily transfer any, or all, project information to your analysis. Data can move seamlessly to and from Bill of Materials (BOM), Excel, Access, text and comma delimited file formats. You can also create and save import and export templates for repeated use. The result is an incomparable time saving over manual data entry.

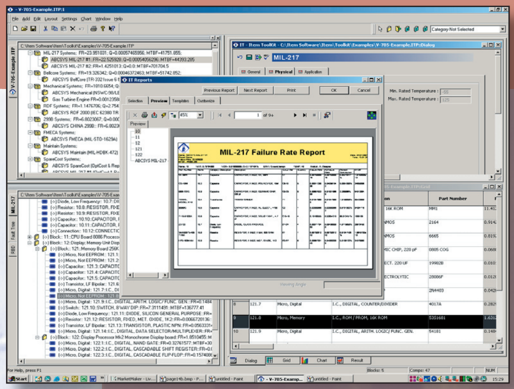
Hierarchy Diagrams

Users can interactively construct hierarchy diagrams that represent the structure of a system at various levels. As new components are added to the system, each module automatically calculates and updates all dependent and overall system results.

Customizable Reports

Choose from a variety of preformatted standard reports or design your own with text, diagrams or graphs that you can preview or print directly.

ITEM ToolKit



- Incorporate bitmaps and company or customer logos
- Specify column widths, fonts and colours
- Modify existing reports and save them as templates for future projects
- Easily generate and manipulate diagrams and graphs

Advance Transfer and Link Facility: A Great Time Saver

Eliminate errors and save time from re-entering data by transferring data from one analysis to another. Analyse your system under one type of analysis then transfer and link it to another type of analysis. This saves time from recreating the same system under another analysis, and it also eliminates errors in re-entering the data. For example; create and analyse a system under the MIL-217 module and transfer the same system to a FMECA or Fault Tree analysis. The system hierarchy is created effortlessly and all relevant information is transferred and updated every time you change or update your MIL-217 analysis.

Advanced Hybrid Linking and Modelling

ITEM ToolKit's hybrid linking and modelling features allow the result of any analysis to be automatically fed into an event in a Fault Tree or a block in a Reliability Block Diagram.

This feature is most useful where a simple model cannot determine the event or the failure of a block, and a more complex analysis has to be performed.

Information Display Management / Sort Option

Specify exactly what type of information is to be displayed in the project, system, library and diagram windows. View and display as much, or as little, of the detailed information such as part numbers, description, failure rate, MTBF or unavailability, or simply your analysis results. Sort the information in numerous ways: by name, by part number, by failure rate, by contribution, by category etc. A great tool for determining and listing items with high failure rates or low MTBF, or listing items by part number etc.

The Most Flexible and Scalable Reliability and Risk Software Application

ITEM ToolKit offers the scalability that every user and organization has in mind. Total integration of ITEM Toolkit allows you to take advantage of one or multiple analyses at the same time. Keeping track of your product life cycle and project management are among the many benefits to such a capable application suite as ITEM ToolKit.

• Build and open multiple systems and project files

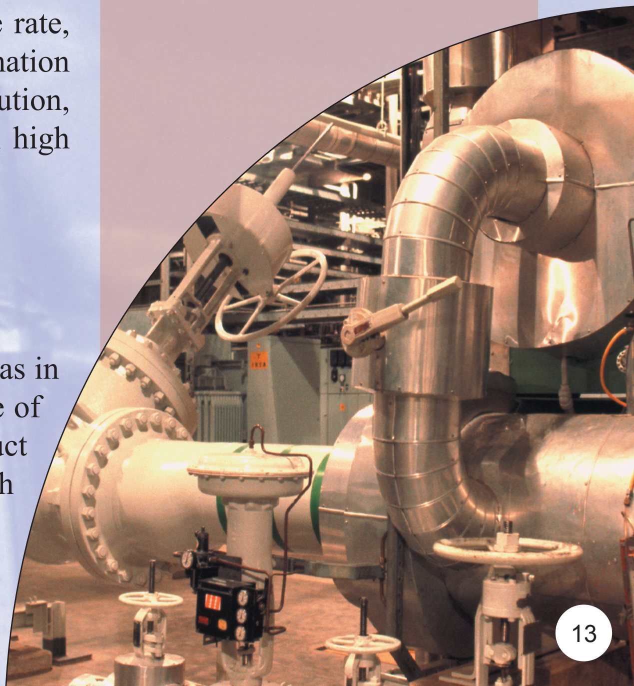
• Drag and drop components and systems between projects

• Powerful charting facilities

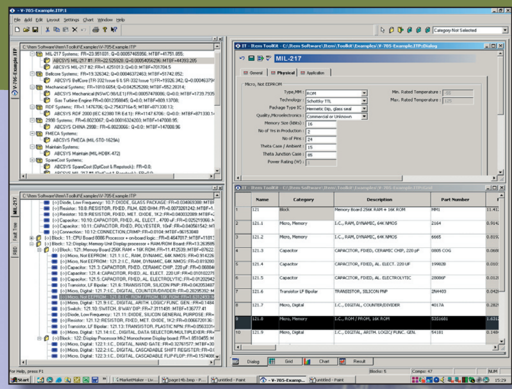
• User defined custom library facilities

• Import and export to MS® Excel, Access, Word, etc.

• Advanced hybrid linking and modelling



Reliability Prediction



Mean Time Between Failures

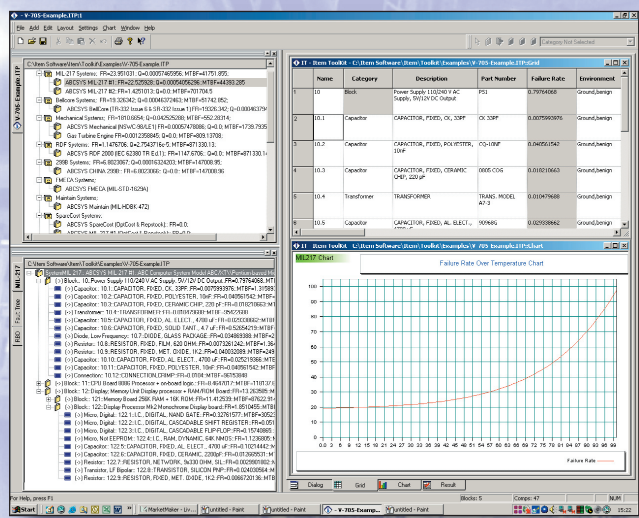
When you develop products and systems for commercial, military or any other application, you need to ensure reliability and consistent performance.

When the reliability of your electronic and mechanical components, systems and projects is critical for mission success, a fully integrated reliability prediction tool such as ITEM ToolKit is absolutely essential.

Electronic and mechanical products, systems and components are naturally prone to eventual breakdown: owing to the number of environmental variables, heat, stress and moving parts. The main question is "When?"

Reliability is a measure of the frequency of failures over time. System reliability has a major impact on maintenance and repair costs as well as the continuity of service and customer satisfaction.

The Role of Reliability Prediction



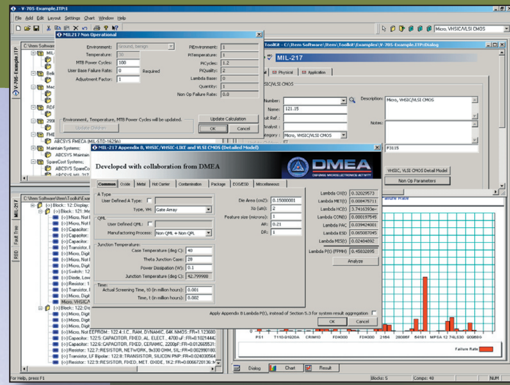
During the reliability analysis or process, reliability prediction or MTBF (Mean Time Between Failure) has many functions and is often the foundation for any analysis. Whether you are designing new, or updating an existing system, ITEM ToolKit's prediction tools can assist in determining the impact of proposed design changes. It also provides a deeper understanding of acceptable reliability levels under environmental extremes. You can evaluate acceptable limits of failure for your system, or meet overall design goals and the requirements of your clients as well.

The ITEM ToolKit prediction modules provide powerful and competitive advantage:

- Combine prediction methods for complex analysis
- Optimize designs to meet targeted goals
- Select components with regard to reliability and cost savings
- Be more accurate and efficient than with manual methods
- Take advantage of powerful "what if" analytical tools.

ITEM ToolKit offers the greatest flexibility and ease of use in six reliability prediction modules. The reliability prediction modules MIL-217, Bellcore / Telecordia, NSWC, IEC 62380 (RDF), IEC 61709 and China 299b all share a powerful set of features and capabilities for inputting and utilizing data in multiple operations. Now you can generate the most complete analysis for your purposes.

Reliability Prediction



MIL-217 Module

Electronic Reliability Prediction
US Military Standard - MIL-HDBK-217F Notice 2

The MIL-217 Module is a powerful reliability prediction program based on the internationally recognized method of calculating electronic equipment reliability defined in MIL-HDBK-217 (published by the US Department of Defense). This standard uses a series of models for various categories of electronic, electrical and electro-mechanical components to predict failure rates that are affected by environmental conditions, quality levels, stress conditions and various other parameters. These models are fully detailed within MIL-HDBK-217.

DMEA

Developed in collaboration with the Defense Micro-Electronic Activity (DMEA) the detail model allows the user to more accurately model the VHSIC and VLSI/CMOS component within the MIL-217 analysis. This in turn leads to a more accurate failure rate and MTBF. The Detail Model goes into greater depth in the physical side of the component, and looks into areas including: common, oxide, metal, hot carrier, contamination and package.

Non-Operating Periods on Equipment Reliability (NonOp)

The ITEM ToolKit MIL-217 Module also supports the calculation of the MTBF and failure rate of equipment during non-operational periods. Based upon the RADC-TR-85-91 standard, this built-in calculation allows you to further refine your analysis.

Custom Connections

The MIL-217 standard is limited as to the types of connection technologies it supports. ITEM has added the ability for you to define custom connection technologies, and their failure rates, for use in the analysis. Any connection technology, such as sonic welding or gold-to-gold solder, with a known failure rate can be used.

BELLCORE / TELCORDIA Module

Electronic Reliability Prediction
US Commercial/Telecom Standard - TR-332 Issue 6 / SR-332 Issue 1

The Bellcore Module of ITEM ToolKit calculates the reliability prediction of electronic equipment based on the Bellcore (Telcordia) standards. These standards use a series of models for various categories of electronic, electrical and electro-mechanical components to predict steady-state failure rates which environmental conditions, quality levels, electrical

• MIL-HDBK-217
US Military
(Electronic)

• Bellcore / Telcordia
US Telecom
(Electronic)

• IEC 62380 (RDF)
European Telecom
(Electronic)

• IEC 61709
European Standard
(Electronic)

• China (GJB/z) 299b
Chinese Military
(Electronic)

•NSWC
US Naval
(Mechanical)

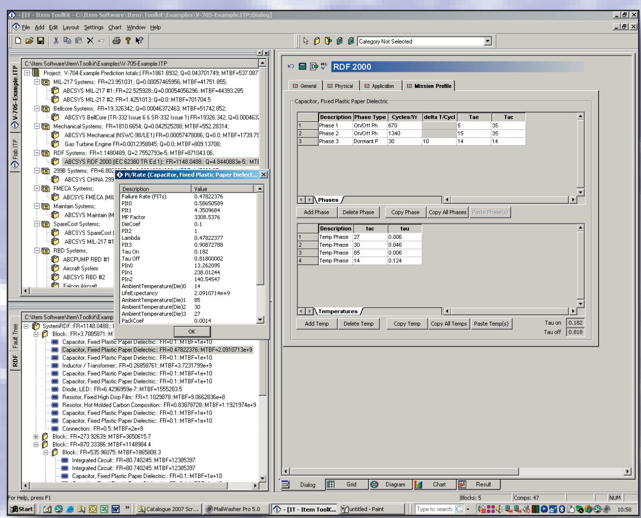
stress conditions and various other parameters, affect. It provides predictions at the component level, system level or project level for COTS (Commercial Off-The-Shelf Parts). The models allow reliability prediction to be performed using three methods for predicting product reliability:

- Method I: Parts Count
- Method II: Combines Method I predictions with laboratory data
- Method III: Predictions based on field data

RDF Module

Electronic Reliability Prediction
European Commercial/Telecom Standard - IEC 62380 (UTEC 80-810)

The RDF module supports reliability prediction methods based on the latest European Reliability Prediction Standard. Originally a French Standard published by the Union Technique de L'Electricite (UTE, July 2000), the standard has evolved and become the European Standard for Reliability Prediction (IEC 62380). Its unique approach and methodology has gained worldwide recognition. IEC 62380 is a significant step forward in reliability prediction when compared to older reliability standards.



The RDF Module provides models for reliability prediction of electronic components, optical cards, printed circuit boards and equipments, taking directly into account the influence of the environment. Environment factors are no longer used as they are replaced by mission profile/ thermal cycling undergone by the equipment. These models can handle permanent working, on/off cycles and dormant applications. Failures related to component soldering are included in the component failure rate.

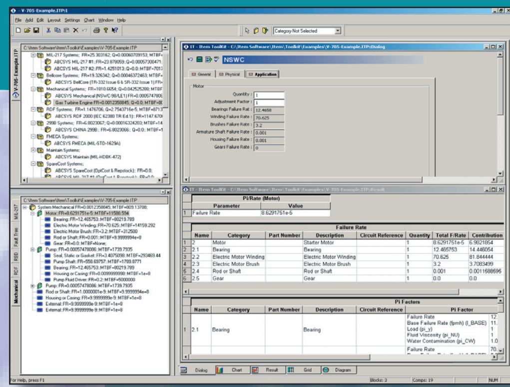
China 299B Module

Electronic Reliability Prediction
Chinese Military/Commercial Standard - GJB/z 299B

The China 299B Module of ITEM ToolKit is a powerful reliability prediction program based on the internationally recognized method of calculating electronic equipment reliability provided in the Chinese Military Standard.

This standard uses a series of models for various categories of electronic, electrical and electro-mechanical components to predict failure rates that are affected by environmental conditions, quality levels, stress conditions and various other parameters.

Reliability Prediction



NSWC Module

Mechanical Reliability Prediction
US Navy Standard - NSWC 98/LE1 & NSWC 06/LE1

The NSWC module uses a series of models for various categories of mechanical components to predict failure rates based on temperature, stresses, flow rates and various other parameters. It provides models for various types of mechanical devices including actuators, springs, bearings, seals, electric motors, compressors, pumps, brakes and clutches and many more. NSWC is currently the only one of its kind.

Due to the wide range of failure rates that occur in apparently similar components, the NSWC mechanical prediction module does not rely on failure rate data alone. It also accounts for material properties, operating environment and critical failure modes at the component level.

The NSWC standard is a commonly used model for mechanical components. Standard procedures for predicting the reliability of mechanical components, sub-systems and systems are defined in the Naval Surface Warfare Center's *Handbook of Reliability Prediction Procedures for Mechanical Equipment.*

IEC 61709 Module

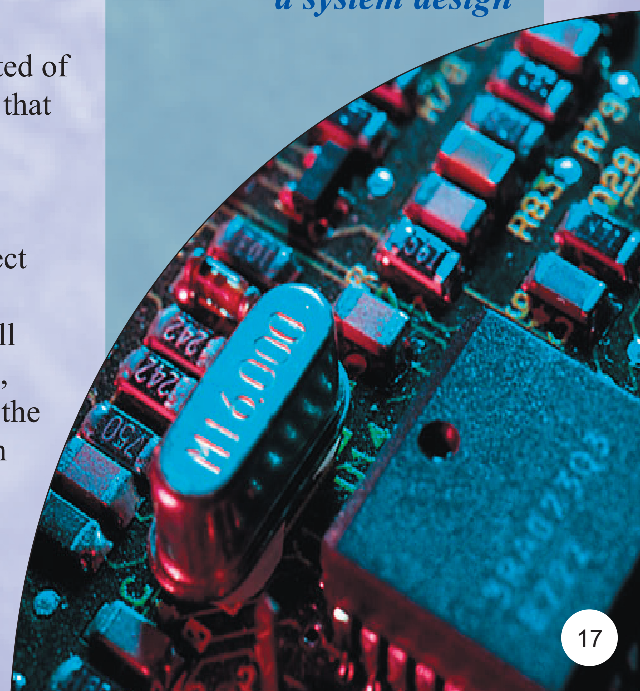
Reliability Prediction
European Electronic Reliability Prediction Standard IEC 61709

The IEC-61709 module supports the reliability prediction methods based on the European Prediction Standard IEC-61709. This module is predominantly based on the Siemens Prediction Standard SN-29500, as well as conforming to section 19 for PCBs and section 20 for the Hybrid Circuits within the European Prediction Standard IEC-62380 (RDF 2000/ UTE C 80-810).

The IEC-61709 module provides models for reliability prediction of electronic components, printed circuit board and equipment extrapolated of failure rates from referenced conditions to other operating conditions that permits the prediction of failure rates at assembly level.

The IEC-61709 module can be used to obtain failure data from other ToolKit prediction modules as well as sourced failure rates, either direct from the component manufacturers or organisations who have failure rate databases that contain collected field reliability data. This data will provide the base failure rate for the ITEM ToolKit IEC-61709 module, which along with the user defined application parameters specified in the IEC-61709 standard, would provide the complete reliability prediction analysis based on the IEC-61709 module.

- *Combine prediction methods for complex analysis*
- *Optimize designs to meet targeted goals*
- *Select components with regard to reliability and cost savings*
- *Be more accurate and efficient than with manual methods*
- *Take advantage of powerful 'what if' analytical tools*
- *Identify weak areas in a system design*



Reliability Prediction

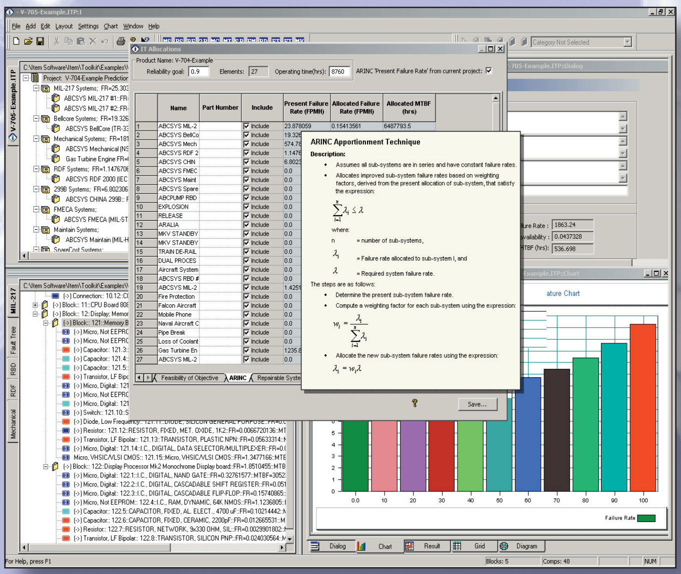
Hierarchy Diagrams

Users can interactively construct hierarchy diagrams that represent the structure of a system at various hierarchical levels. As new components are added to the system, each module automatically calculates and updates all dependent and overall failure rates.

Parts Count & Parts Stress Analysis

When adding components to your system, ITEM ToolKit automatically employs the applicable default values (**Parts Count**). The Parts Count generally requires less information, such as part quantities, quality levels and the application environment. It is most applicable early in the design phase and proposal formulation.

You have the option of modifying these values to meet specific system or project requirements (**Parts Stress**). The Parts Stress Analysis requires more detailed information and is usually applicable later in the design phase.



MTBF & Failure Rate Calculations

MTBF and failure rates are automatically computed and displayed for all levels of systems and projects.

Redundancy and Repairable Calculations

Each module includes redundancy and repairable options for calculations of availability and failure rates at block and system levels.

User Defined Linked Blocks

A Linked Block is a graphical representation of an existing block that assumes the exact characteristics of another block in your System. Linked Blocks enable you to reduce repetitive data entry. Changes made to the source block will automatically update in the Linked Block.

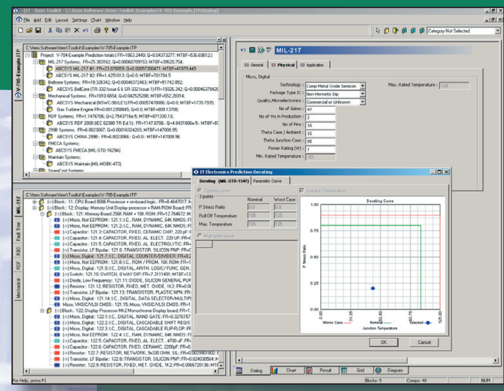
Pi Factors

Each module calculates, and makes visible, the various Pi Factors used to calculate the failure rates for the component categories per the applicable standard being used.

"What If" Study

"What if" studies allow you to preview and evaluate the feasibility and quality of your design and the selection of your components. This allows you to model the system, change components and see the effects without having to construct an actual system.

Reliability Prediction



External Arrhenius Temperature Model for User Defined Failure Rates

For some designs you may use a component which cannot be modelled using a component category known to the standard, or you have a failure rate from a manufacturer of a subassembly. By using the external component and the Arrhenius temperature model, you can introduce a non-standard component into your analysis, and vary the failure rate with temperature via the Arrhenius temperature formula.

Reliability Allocation

Allocation models logically apportion the product design reliability into lower level design criteria such that the cumulative reliability still meets the requirements. ITEM ToolKit performs allocation analysis at two levels: project and system level.

ITEM ToolKit contains the following five allocation models:

- Equal Allocation
- AGREE Allocation
- Feasibility of Objective Allocation
- ARINC Apportionment Technique
- Repairable Systems Allocation

Derating

Derating is the selection and application of parts and materials so that the applied stress is less than rated for a specific application. For example: derating is the negative slope of a power-versus-temperature graph. It shows that as the operating ambient temperature increases, the output power of a particular component drops to ensure reliable system operation. Derating curves provide a quick way to estimate the maximum output power of a device at a given temperature.

Following are the commonly used derating standards that are included within ITEM ToolKit:

- NAVSEA TE000-AB-GTP-010
- MIL-HDBK-1547
- MIL-STD-975M (NASA)
- NAVAIR-AS-4613 Class A
- NAVAIR-AS-4613 Class B
- NAVAIR-AS-4613 Class C
- User Defined Derating Files

• Powerful charting facilities

• Multi-document interface allows easy transfer of data

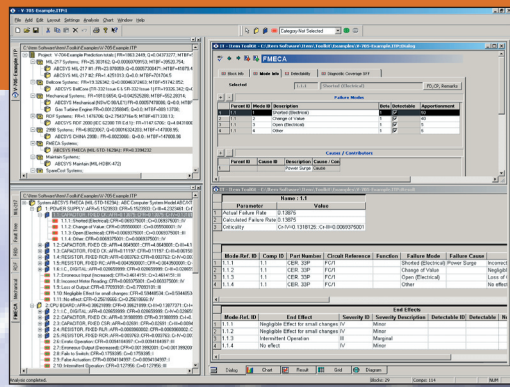
•Extensive component libraries to reduce entry time

• Multi systems within the same project

• Redundancy modelling including hot standby

• Linked Block facility reduces repetitive data entry

FMECA Module



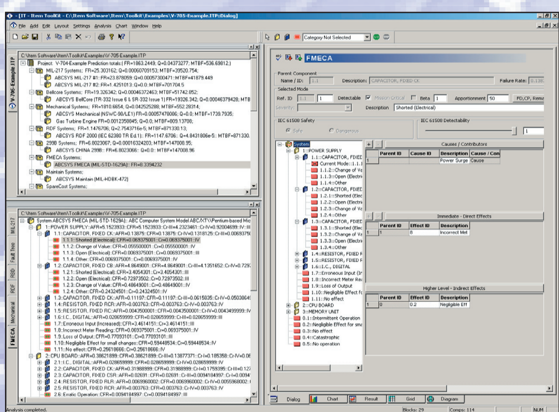
Failure Mode, Effects and Criticality Analysis

Not being able to identify your design flaws, failures in manufacturing or processes could result in costly repairs, warranty costs, production delays, catastrophic failures and even loss of life.

Organizations perform Root Cause Analysis to identify and eliminate severe malfunctions and potential failures from products and production processes. An inductive approach or procedure often serves as a design aid to identify and prevent catastrophic failures. The need to determine the effect of system and equipment failure becomes more evident and urgent.

FMECA (Failure Mode, Effects, and Criticality Analysis) analyses potential failure within a system, identifies the potential hazards associated with these failures and classifies them according to their severity. FMECA addresses reliability and quality problems associated with design, manufacturing, process, safety and environment.

There are many published approaches to performing a FMECA. ITEM ToolKit supports the following: MIL-STD-1629a, IEC-61508, ISO9000/QS9000 and BS 5760 Part 5. However, the use of the FMECA module is not limited to these standards. Your specific FMECA needs can easily be modelled.



Two-Part Analysis

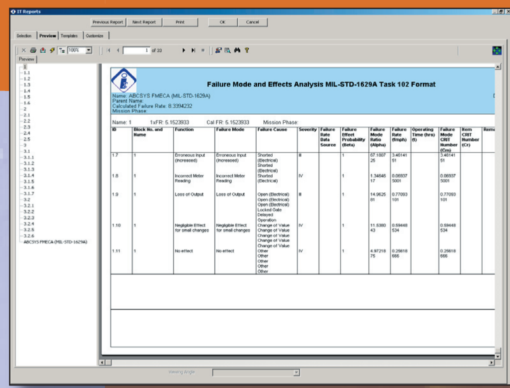
During a FMECA procedure, identifying the failure modes and their effects (Failure Mode Effect Analysis) is often only the beginning. Criticality Analysis is where the failure modes are ranked according to a combination of severity and the probability of that failure mode actually occurring. ITEM ToolKit provides total flexibility for applying FMECA to the two-part analysis, and much more.

The ITEM ToolKit FMECA module provides an intuitive graphical interface with multiple options for constructing and performing an analysis. With an enhanced hierarchy tree and tabular views designed for user-friendly navigation, data entry and modification have never been easier. The FMECA module provides a coherent, and comprehensive, method for entering data.

The FMECA module also provides a phrase library facility containing commonly used descriptions of component parts, failure modes and effects. These greatly speed up data entry and have the added benefit of keeping common phrases consistent. Phrases in this library may be customized to suit your own requirements.

The FMECA module also includes a failure mode and apportionment library, derived from MIL-

FMECA Module



HDBK-338, which allows you to create commonly used component and failure mode groupings. The apportionment library can either be used when manually creating FMECAs or to automatically create failure modes and apportionments when transferring data from ITEM ToolKit's prediction modules. This capability can dramatically reduce analysis times, making you more productive.

The FMECA module now incorporates a fully integrated IEC-61508 FMEDA analysis. An IEC-61508 conforming quantitative FMEDA analysis is now only a few mouse clicks away.

FMECA Special Features

ITEM ToolKit FMECA provides unique features that allow you to quickly and accurately perform your Failure Mode, Effects, and Criticality Analysis, data management, reporting, analytical facilities and much more.

- Assign Risk Priority Numbers as needed
- Graphically constructed system hierarchy diagrams
- User-definable data fields and sort facilities
- Failure effects and severities traced through to system hierarchy
- Automatically assigned severity values
- User-definable severity category and matrix
- Automatic criticality calculations
- Multiple failure effects permitted for a single failure mode
- Effects may be defined on any higher-level sub-system
- Libraries of components with predefined modes and apportionment
- Optimization of design to meet acceptable failure modes and severity
- Assignment of IEC "dangerous" versus "safe" at the functional end effects level
- Regressional top down analysis assigning safe versus dangerous severity to root modes
- Evaluation of multiple severity assignment by a "split by hit" algorithm
- Independent IEC analysis algorithm for the functional end effects of the FMEDA
- Hardware oriented component level Detectability Coverage and Safe Failure Fraction
- Automatic calculation of lambda-SU, lambda-SD, lambda-DU and lambda-DD, per each root mode
- Consideration of non propagating root modes in component Detectability Coverage and Safe Failure Fraction
- Cut set analysis at each intermediate nodal point of the FMEDA
- Automatic transfer from FMEDA to FTA with failure model and inspection interval
- End-effect trace down to root causes

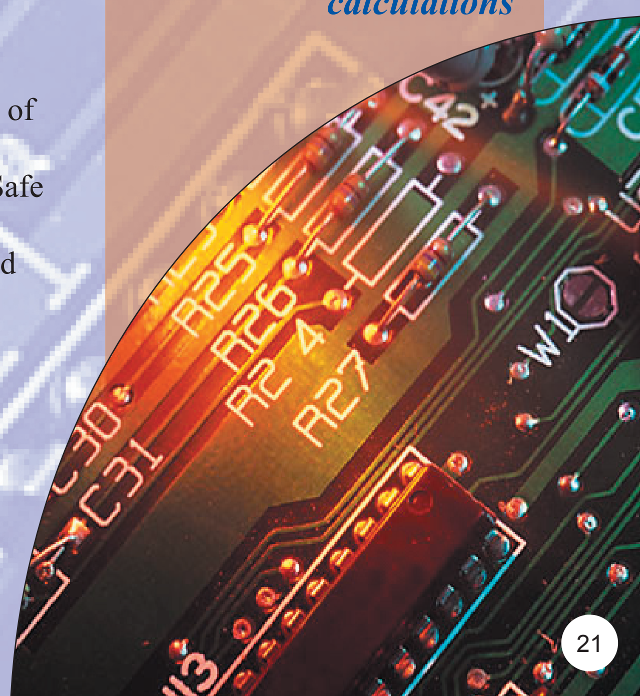
• Supports standards: MIL-STD-1629a IEC-61508 FMEDA ISO9000/QS9000 BS 5760 Part 5

• Phrase, failure mode and apportionment library facilities

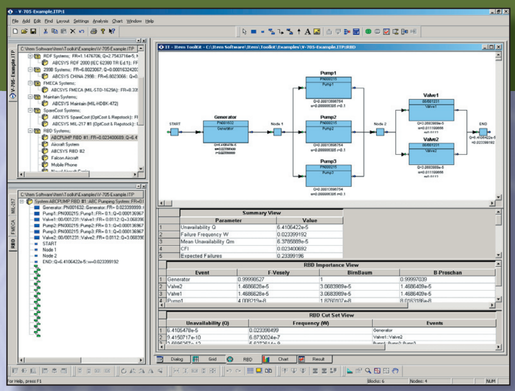
• Graphically constructed system hierarchy diagrams

• Optimization of design to meet acceptable failure modes and severity

• Automatic criticality calculations



RBD Module



Reliability Block Diagram

Do you need to analyse the reliability and availability of systems and sub-systems, and their failures with respect to parallel and series arrangements? Model your system's true redundancy or logical configuration, and evaluate the availability of the system during or after the design phase. Regardless of the system size and complexity, the Reliability Block Diagram module graphically represents the logical interaction of failures and other events within your systems.

As part of the ITEM ToolKit integrated program, the Reliability Block Diagram (RBD) module offers easy construction of network diagrams using point and click or drag and drop techniques. Once complete, Boolean Algebra expressions are used to determine minimal cut sets or the minimum combination of failures required to cause a system failure. As well as 15 built-in failure models, Markov models can be used for standby systems with respect to maintenance arrangements. RBD calculates system failure frequency and unavailability.

Helian Model

The Reliability Block Diagram module also features a capability to estimate performance degradation due to the unavailability of one or more blocks in the system. This Helian model feature allows the user to allocate processing capacities to each block in the model, and computes the reduced throughput of the system in case of partial system failure

RBD Construction

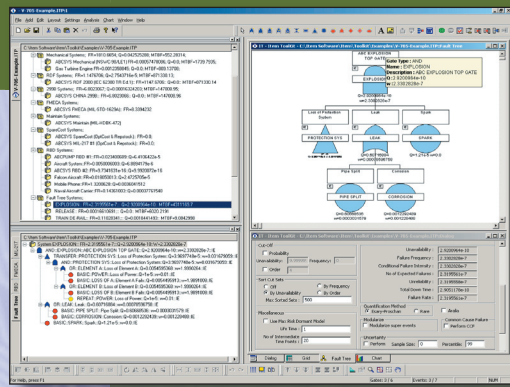
ITEM ToolKit's RBD module offers powerful, yet flexible, options to construct the block diagram using different approaches. Using point and click or drag and drop techniques will allow you to construct your diagram efficiently. ITEM ToolKit's standard editing capabilities provides you with additional flexibility: from entering failure data to changing the colours of the blocks, or simply printing the diagram. As your systems are configured properly, and block data is provided, the failure rate, MTBF, reliability and availability of the system can be calculated. When the configuration of the diagram changes, the calculation results also change.

The Value of RBD Features

Performing a Reliability Block Diagram analysis is essential for determining unreliability, unavailability, expected number of failures and down time.

- Establishes reliability goals
- Evaluates device failure impact on overall system safety
- Provides a powerful "what if" analysis tool
- Allocates device reliability by calculating system MTBF
- Estimates system reliability
- Uses efficient minimal cut sets to derive the causes of system failures
- Determines system sensitivity to component failures through Importance Analysis

Fault Tree Module



Fault Tree Analysis (FTA)

To address safety and the ways failures or undesirable events could occur, and thereby trying to avoid them, can be very challenging. To improve system safety and reliability, designers and analysts have to make better-informed risk assessment decisions based on quantified evaluations of the risks and effects associated with alternative designs, and other risk-mitigating actions.

These challenges are more compounded where manual methods of fault isolation and risk analysis, in large and complex systems, are not viable.

Using failure probability and system reliability data can assist you in addressing the undesirable events or challenges. Often, fault trees are used in reliability and safety risk assessments to represent graphically the logical interactions and probabilities of occurrence of component failures, and other events in a system. Fault trees use tree structures to decompose system level failures into combinations of lower-level events, and Boolean gates to model their interactions.

A fault tree analysis identifies and ranks combinations of events, represented on a fault tree, that cause system failure, and provides estimates of the system's failure probability.

Using this detailed information, efforts to improve system safety and reliability can be highly focused and tailored to your individual system by using the quantitative results from the data you input. Additionally, fault tree analysis can help prevent failures from occurring by providing you with data showing how, and under what circumstances, the failure *could* occur; allowing for alternative measures to prevent (or design out) the catastrophic failures or hazards.

The Boolean methodology and equations are used to construct and simplify the fault tree. As fault trees are constructed, the Boolean equations are used to evaluate the quantitative and qualitative characteristics of a critical system.

The qualitative analysis of the fault tree determines: the probability of system failure (top event) based on a single failure (basic event) cause or common cause potential, using minimal cut sets; the combination of component failures (minimal cut sets); the importance ranking of contributors to system failure.

The quantitative analysis of the fault tree focuses on the probabilities of system and cut set failure, or the occurrence of the top event based on the probabilities of failure of the basic events.

• Calculates unreliability and unavailability

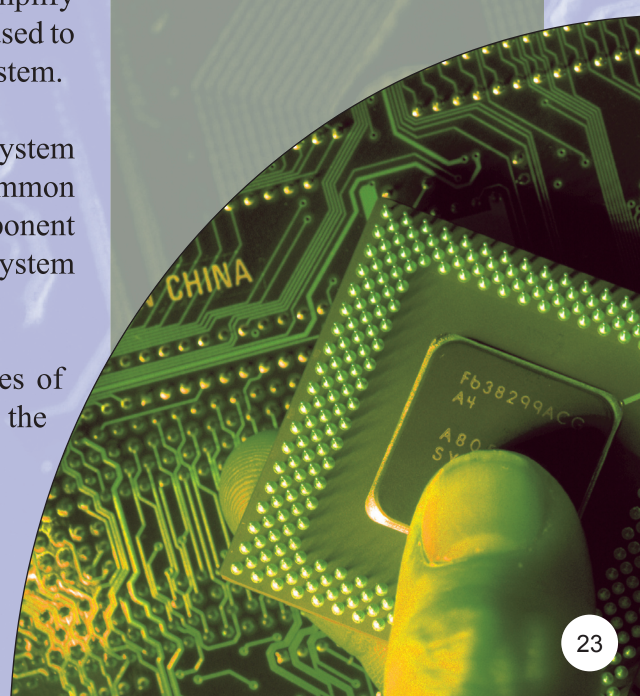
• Analyses uncertainty, sensitivity and Common Cause Failure (CCF)

• Produces minimal cut sets

• Identifies fault tree sequencing

• Defines event failure models

• Determines the importance of elements in a system



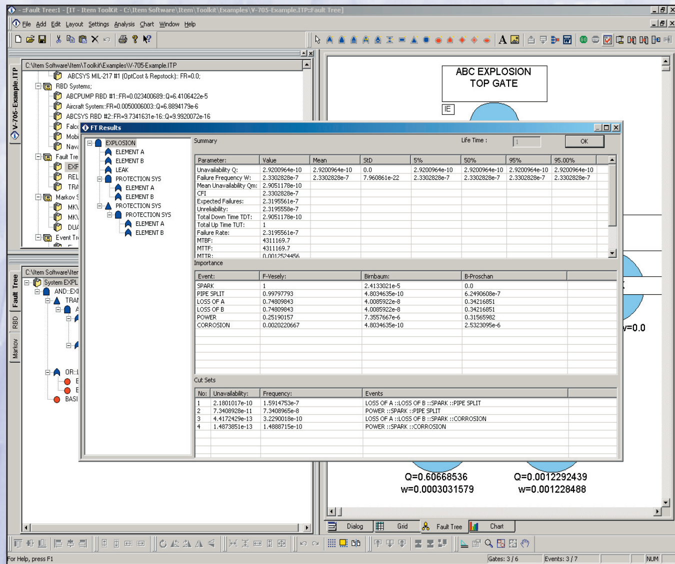
Fault Tree Module

Fault Tree Construction

ITEM ToolKit Fault Tree offers a diverse graphical user interface (GUI) for flexible, powerful and easy ways to construct fault trees. The GUI consists of menus, toolbars, project and system windows. You can simply add different gates and events in the system window to create a hierarchy of your system, ToolKit will construct the fault tree diagram for you. Or, you can build your fault tree the traditional way by adding gates and events in the diagram window.

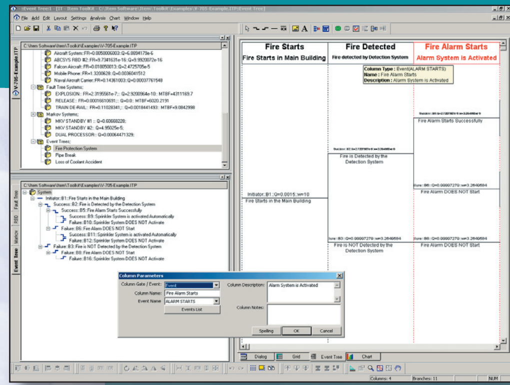
The Value of Fault Tree Features

ITEM ToolKit's Fault Tree analysis incorporates two independent calculation engines: binary decision diagram (BDD) and the approximation method. It provides methods to calculate unreliability and unavailability, analyse uncertainty and sensitivity, analyse common cause failure (CCF), produce minimal cut sets, identify fault tree sequencing, initiator and enabler, initiator only, enabler only, define event failure models, and determine the importance of elements in a system.



- Allows 15 failure models, 9 types of gates, 4 types of events, and 4 CCF models
- Handles multiple time phases for a single event
- Analyses uncertainty using Latin Hypercube Sampling (LHCS)
- Converts CAFTA® models automatically
- Analyses importance
- Creates new projects by reusing data from other projects
- Allows copying and pasting of gates and events between projects
- Simultaneously displays results and fault tree diagram
- Allows dragging and dropping of gates and events between libraries and projects
- Displays various gate and event information on the diagram
- Displays various system and project information in the hierarchy window
- Sorts events by name, unreliability or manually
- Edits project, system, gate and event information and parameters using dialog and grid views
- Allows changing of colour and sizes of gates and events
- Allow system navigation using system hierarchy and diagram windows
- Adjusts and resizes labels and text boxes

Event Tree Module



Event Tree Analysis (ETA)

Event tree analysis (ETA) is used to determine the path from an initiating event to the various consequences, and the expected frequency of each consequence. Pipes breaking, alarms not activating and humans not performing actions are all examples of events that can lead up to insignificant, or catastrophic, consequences. Event trees model these initiators and consequences, and determine their frequencies.

• Full minimal cut set evaluation

• Easy to use graphical user interface

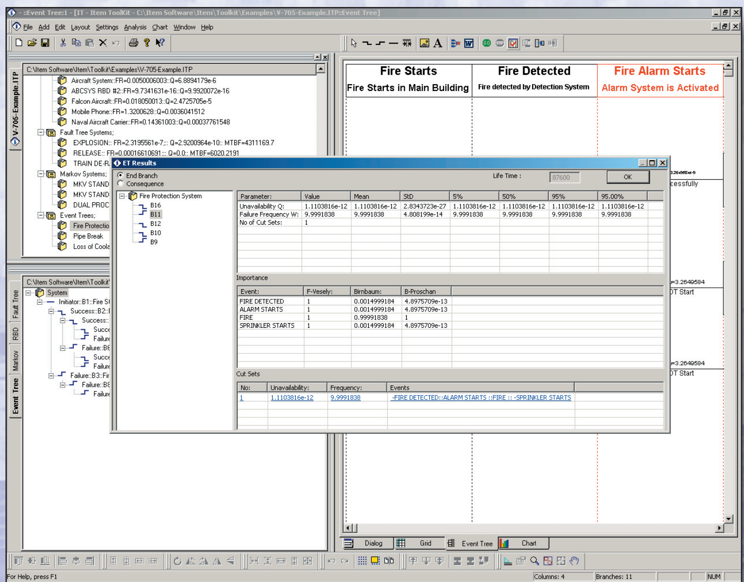
• Calculate importance values

• Links to Fault Tree Module

• Column links to RBD and Markov modules

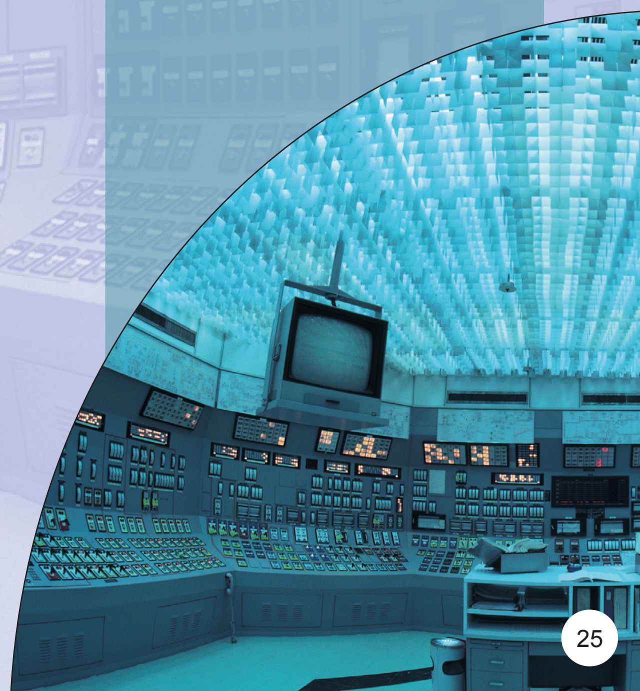
• Plot F-N Curve graphs (frequency versus consequence)

The Event Tree module uses the logic diagram and consequences you create to provide an analysis of the scenarios the diagram presents. You can quantify the various events using stand-alone gates and events, or gates and events from fault trees in the same ToolKit project file. Cut set and other important analysis results can be displayed and reported in several different ways, just like other ToolKit modules.



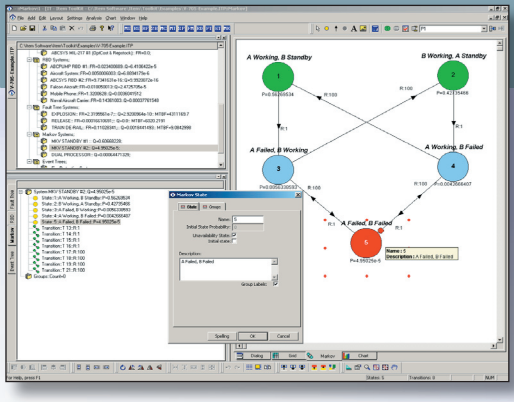
Module features include:

- Links to the Fault Tree module
- Column links to the RBD and Markov modules
- Full minimal cut set evaluation
- Easy to use graphical interface
- Plot F-N Curve graphs (frequency versus consequence)
- Calculate Importance values



Markov Module

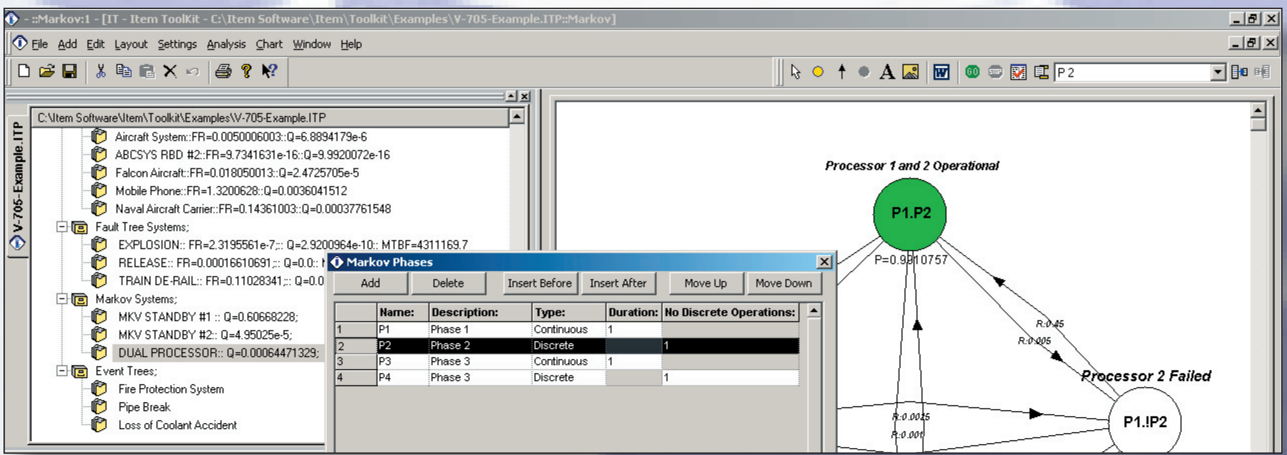
Markov Analysis



Markov analysis is a powerful modelling and analysis technique with strong applications in time-based reliability and availability analysis. The reliability behavior of a system is represented using a state-transition diagram, which consists of a set of discrete states that the system can be in, and defines the speed at which transitions between those states take place. Markov models consist of comprehensive representations of possible chains of events, i.e. transitions within systems which, in the case of reliability and availability analysis, correspond to sequences of failures and repair.

The Markov model is analysed in order to determine such measures as the probability of being in a given state at a given point in time, the amount of time a system is expected to spend in a given state, as well as the expected number of transitions between states: for instance representing the number of failures and repairs.

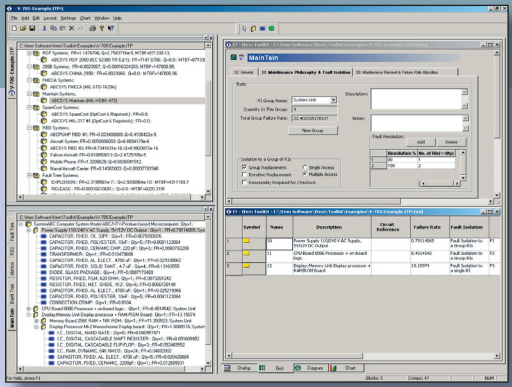
Markov models provide great flexibility in modelling the timing of events. They can be applied when simple parametric time-based models, such as exponential or Weibull time-to-failure models, are not sufficient to describe the dynamic aspects of a system's reliability or availability behavior; as may be the case for systems incorporating standby redundancy.



Highlights of the module's features include:

- Powerful graphical Markov model editor
- Phased-mission models
- Discrete and continuous time transition models
- Flexible definition of states and groups of states
- Markov models can be used to quantify fault tree, RBD, and event tree events

MainTain Module



Maintainability

The Maintainability module of ITEM ToolKit provides an integrated environment for predicting the expected number of hours that a system, or a device, will be inoperative, or "down", while it undergoes maintenance, based upon the tasks needed to repair the system.

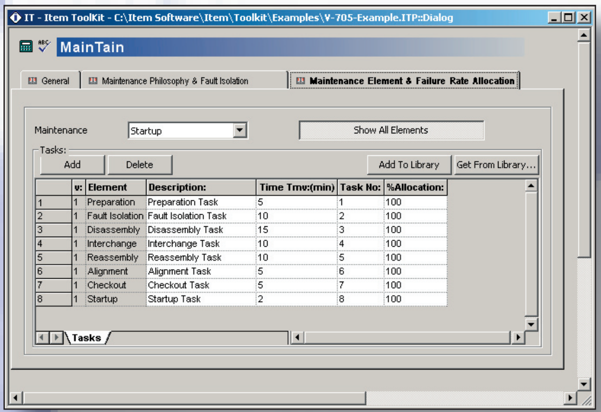
Conforms To Rigorous Standards

A comprehensive design tool for calculating MTTR, MainTain conforms to maintenance standards established in MIL-HDBK-472, Procedure V, Method A.

Built-in Maintenance Planning

MainTain provides built-in elemental maintenance action, maintenance philosophy and fault isolation parameter groups to provide a foundation for the analysis. You can also save common maintenance tasks to a library for repetitive use. The following results are calculated for a component or group of components:

- Mean Time To Repair (MTTR)
- Mean Man Hours (MMH)
- Mean Man Hours per Repair (MMHR)



Use MainTain early and often to:

- Identify areas with potential maintainability problems
- Make repair, replace and design decisions
- Perform early assessment of downtime and personnel requirements
- Plan for necessary tools and test equipment
- Easily identify Replaceable Items (RIs)
- Save and link essential data for use in other ToolKit modules

• Conforms to MIL-HDBK-472, Procedure V, Method A

• Mean Time To Repair (MTTR)

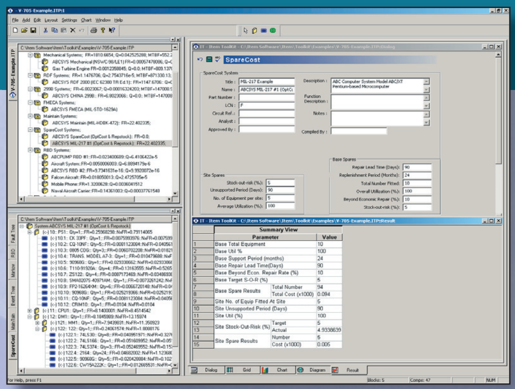
• Mean Man Hours (MMH)

• Mean Man Hours per Repair (MMHR)

• Built-in Maintenance Planning

• Identifies Replaceable Items (RIs)

SpareCost Module



Spares Scaling and Ranging

The SpareCost module of ITEM ToolKit calculates spares required for equipment supported at sites and bases; enabling you to optimize the scale of spares at sites for minimum cost. It works to algorithms derived for the Ministry of Defence: Optcost and Repstock.

Sites

The SpareCost module generates spares holdings required at sites (first and second line repair by replacement), against a stock-out risk at the site. This scale of spares is optimized against cost of the spares held.

Base

Base spares are required to meet replenishment demands from sites and to replace returned spares which are beyond economic repair. SpareCost calculates the most cost effective base spares holding.

IT - Item ToolKit - C:\Item Software\Item\Toolkit\Examples\V-705-Example.ITP::Result

Base Spare Results

	Name	Description	Qty	Cost	F/Rate (fpmh)	Bkup Stock	Repl Stock	Total Stock	Actual SOR(%)
28	121.4	CAPACITOR, FIXED, AL. ELECT. 220 UF	1	1	0.010102279	1	1	2	8.5053076e-10
29	121.5	CAPACITOR, FIXED, AL. ELECTROLYTIC	1	1	0.01202942	1	1	2	1.4359736e-9
30	121.6	TRANSISTOR, SILICON PNP	7	1	0.006007641	1	1	2	6.1299921e-8
31	121.7	I.C., DIGITAL, COUNTER/DIVIDER	4	1	0.070738479	1	1	2	1.8549001e-5
32	121.8	I.C., ROM / PROM, 16K ROM	8	1	0.20390616	1	1	2	0.0034248109
33	121.9	I.C., DIGITAL, ARITH. LOGIC/ FUNC. GEN.	1	1	0.14842211	1	1	2	2.6870614e-6
34	121.10	SWITCH, 8 WAY DIP	1	1	7.3111491	2	1	3	0.017477986
35	121.11	DIODE, SILICON GENERAL PURPOSE	1	1	0.0019542354	1	1	2	6.17284e-12
36	121.12	RESISTOR, FIXED, MET. OXIDE, 1K2	1	1	0.0066720136	1	1	2	2.4504843e-10
37	121.13	TRANSISTOR, PLASTIC NPN	4	1	0.014083285	1	1	2	1.4729054e-7

Site Spare Results

	Name	Description	Qty	Cost	F/Rate (fpmh)	Exp No Of Fails	No. Of Spares	Actual SOR(%)
11	10.11	CAPACITOR, FIXED, POLYESTER, 10nF	5	1	0.0081123084	0.00058408623	1	1.1920929e-5
12	10.12	CONNECTION,CRIMP	1	1	0.0104	0.00014976	1	0.0
13	11.1	I.C., DIGITAL MICROPROCESSOR	1	1	0.30777195	0.0044319159	1	0.00098347664
14	11.2	I.C., DIGITAL, COUNTER/DIVIDER	5	1	0.064670324	0.0046562632	1	0.001084964
15	11.3	I.C., DIGITAL, UNIV. MULTIPLEXER, 3 ST.	1	1	0.064053245	0.00092236674	1	4.7683716e-5
16	11.4	SWITCH, 8 WAY DIP	1	1	7.3111491	0.10528055	3	0.00047087669

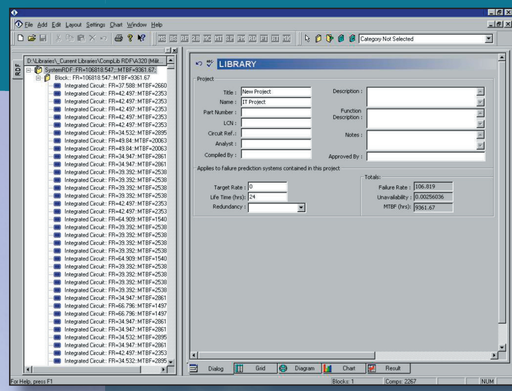
Reports

The SpareCost module has an extensive reports facility that includes full information of spares holding by replacement item at both site and base, as well as the expected number of failures for each component over a defined period.

Features

- Uses Optcost and Repstock for spares scaling
- Tree control for structured project breakdown
- Identifies and calculates your stock out risk
- Analyses at site and base (depot) level

Libraries



ITEM ToolKit Component Libraries

ITEM ToolKit includes comprehensive libraries for specific applications as part of our standard features. They include thousands of parts, with associated data parameters, that will save time and reduce costs. Library system files contain information regarding blocks, linked blocks and components: the same as regular system files. These system files are internal to ToolKit and are saved under the library project file of the same analysis type. Multiple system library files can be saved under the same library project file. ITEM ToolKit automatically updates and transfers library system file information to the library project file as items are being added to the system library files. ITEM ToolKit also has a part number matching capability during import from BOM, and during direct data entry.

User Defined Libraries

In your analysis project, some component types, blocks of components, or even an entire system, will appear more frequently. Input of these repetitious occurrences is tedious. Libraries can be created to tabulate these component types for later use. Libraries are created when a group of common blocks and or components are copied and saved to a library. You can use the saved blocks or components to quickly add these components, along with their analysis data, to a new or existing project. Libraries may be built and customized using the library management facility. Data can also be transferred between different projects and from libraries. You can create your own libraries and use them separately or in conjunction with ITEM Software's libraries.

Library Services

If you have Bill of Materials, purchasing or stock lists, why not let us create your own custom parts library; thus saving you precious time and money.

Browse and Search the Libraries

ITEM ToolKit's library management tool lets you browse and search the loaded libraries. Just type in the first letters or numbers and a drop down list will be displayed, giving you the ability to choose the desired component.

- ***Automatic update and transfer of libraries***
- ***Multiple systems in library projects***
- ***Part number matching capabilities***
- ***Library management facilities to build and customize libraries***

Customers

Our leading software tools are in use around the globe, and our many satisfied customers include:

3COM
3M
Aerojet
Airbus
Alcatel-Alenia Space
Alcatel-Lucent
Alcon Surgical
Allen Bradley-Rockwell Automation
Allied Signal Aerospace
Alstom Transport
Altair Avionics
AnsaldoBreda
Astrium
AT&T
BAE Defense
BarcoView Texen
Baxter Healthcare Corporation
Bayer Corporation
Beijing Aerospace
BF Goodrich Avionics
Boeing
Bombardier
Bosch Group
British Aerospace
Bureau Veritas
Chevron
Chrysler
Danfoss
Delphi Electronics
Delphi Mechatronics
Department of Defense
DuPont
EADS
Eastman Kodak
Eclipse Aviation
Ericsson
Eurocopter
European Space Agency
Faiveley Transport
Ferranti
Fiat
Ford
Fujitsu
General Dynamics
General Electric Medical
GKN Aerospace Packard
Gulfstream Aerospace Corp
Harvard Medical School
Hispano-Suiza
Hitachi
Honeywell
Hyundai
Intel
ITT
Iveco
Jaguar Cars
Jet Propulsion Laboratories
Johnson Controls
Knorr-Bremse
Kodak
Korean Aerospace Research Institute
L-3 Communications
Land Rover
Liebherr-Aerospace
Lockheed Martin
McDonnell Douglas
Meggitt Safety Systems
Mercedes Benz
Messier-Bugatti
Messier-Dowty
Mitsui
MOOG Inc.
Motorola
NASA
Naval Surface Warfare Center
New York Air Brake
Nokia
Nortel
Northrop Grumann
Philips
Pitney Bowes Inc.
Raytheon
Renault
Rolls Royce
SAAB Aerospace
SAFRAN Group
Samsung
Schlumberger Technologies
Seagate Technology
Siemens Transportation
Smiths Industries
SNECMA
Southwest Research Institute
Suez-Tractebel
Texas Instruments
Thales Group
Toshiba Corp.
Toyota (UK)
TRW
United Defense
University of Maryland
US Nuclear Regulatory Commission
VALEO Group
Volkswagen
Vosper Thornycroft
Westinghouse
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