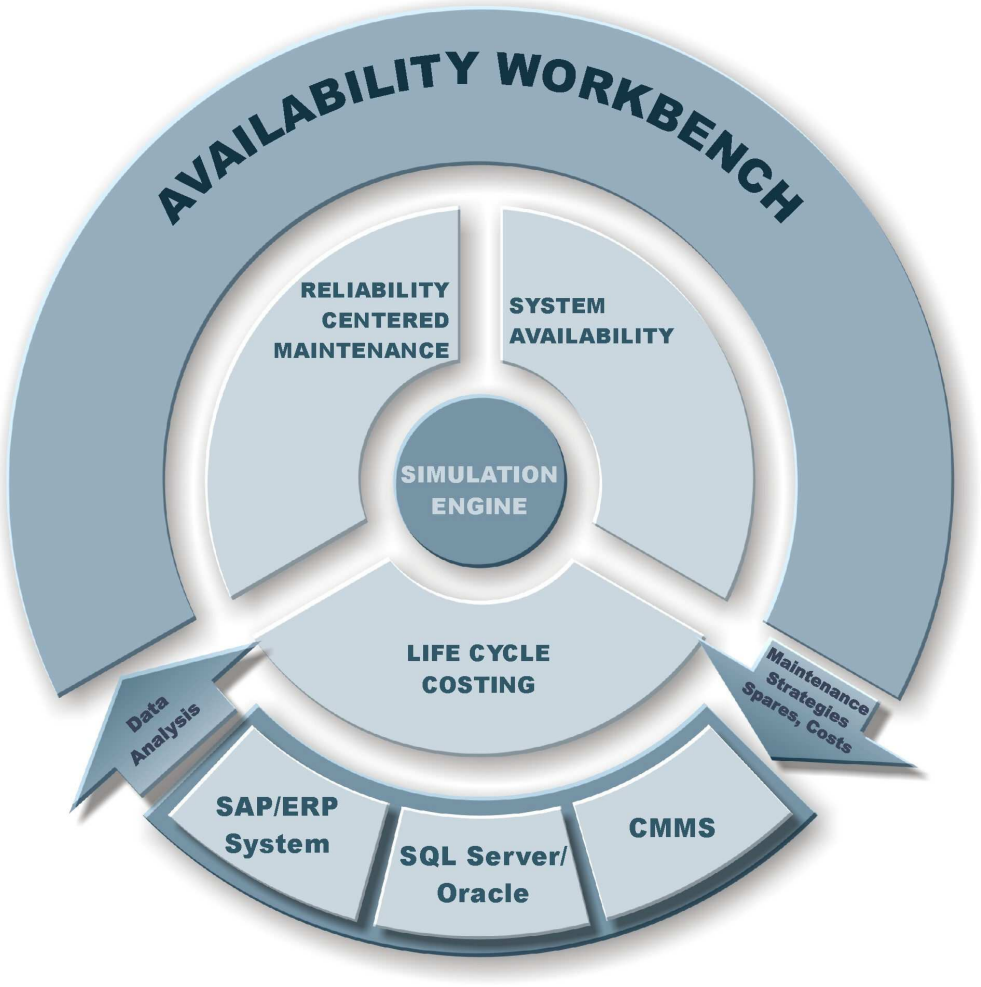
Introduction

Availability Workbench Functional Summary

Welcome to the Availability Workbench (AWB) simulation program for Microsoft Windows. Availability Workbench provides a fully integrated environment for:

- Developing and maintaining a Reliability-Centered Maintenance (RCM) program
- Performing full system availability predictions taking into account complex dependencies on spares and other resources
- Performing a Life Cycle Cost Analysis
- Process Reliability Analysis

AWB interfaces seamlessly with external databases and applications through its sophisticated import/export facility and dynamic link library. AWB integrates the functionality of Isograph's RCMCost and AvSim products that have been serving the Reliability and Maintenance Community since 1988.



AWB contains five fully integrated modules:

RCMCost Module (Reliability-Centered Maintenance)
AvSim Module (System Availability Simulation)
Life Cycle Cost Module (LCC Module)
Weibull Module
Process Reliability Module

Each module may be licensed separately depending on the user's needs. For example, the RCMCost and Weibull modules provide the data management, reporting and analytical facilities for developing and maintaining a RCM programme. The Avsim module will enable you to analyze the availability and reliability of both complex and simple systems and optimize spares holdings, design configurations,

opportunistic maintenance policies and much more. The LCC module will allow you to create a cost node structure and integrate predicted maintenance and operational costs with other user-defined cost equations. The Weibull module analyzes incoming historical data to provide the prediction distributions required by the RCMCost and AvSim modules.

Through its sophisticated simulation and modelling capabilities Availability Workbench can answer questions such as:

- Is planned maintenance cost effective, and if so, how often should it be performed?
- What design improvements (adding redundancy or upgrading equipment) are cost and safety effective?
- What is the likely spares usage profile?
- What is the optimum level of spares to be held on site and at a depot?
- How can labor and equipment usage be improved?
- How can buffers best be employed to maintain capacity?
- How can risk be reduced?
- What are the likely life cycle costs?
- What is the best frequency for performing major overhauls?
- Is predictive maintenance worth doing?
- Would combinations of predictive methods be effective?
- Is inspection for hidden failures cost effective?
- What is the effect on availability of rotating equipment?
- How do ageing assets affect life cycle costs?
- How do operational phases affect system availability?
- Is opportunistic maintenance worthwhile?

Introduction to the RCMCost Module

What is Reliability-Centered Maintenance ?

Reliability-Centered Maintenance (RCM) is a procedure for determining maintenance strategies based on reliability techniques and encompasses well-known analysis methods such as Failure Mode Effects and Criticality Analysis (FMECA). RCM procedures take into account the prime objectives of a maintenance programme, which are to:

- Minimize Costs
- Meet Safety and Environmental Goals
- Meet Operational Goals

The RCM process begins with a failure mode and effects analysis that identifies the critical plant failure modes in a systematic and structured manner. The process then requires the examination of each critical failure mode or cause to determine the optimum maintenance policy to reduce the severity of each failure. The chosen maintenance strategy must take into account cost, safety, environmental and operational consequences. The effects of redundancy, spares costs, maintenance labor costs, equipment ageing and repair times must also be taken into account along with many other parameters.

Once optimal maintenance policies have been recorded the RCM process provides system performance predictions and costs, expected spares requirements and labor manning levels. The RCM process may be used to develop a living strategy with the plant model being updated when new data is available or design changes take place.

How does the RCMCost Module of Availability Workbench Help?

The RCMCost module of Availability Workbench (AWB) provides the full framework for building the RCM model to represent your system. It provides facilities for storing RCM data and analyzing maintenance alternatives. It provides simulation algorithms to predict lifetime maintenance costs, spares costs and usage, maintenance labor manning requirements, safety and environmental risks and operational performance. In addition the RCMCost Module identifies critical failure modes (causes) and compares the cost, safety and operational benefits of different maintenance intervals. AWB is designed to combine well-established reliability prediction techniques with engineering experience. The program does not decide on which maintenance policy or combination of policies to adopt. Instead it advises the individual user or workgroup based on the operational data provided. The program may be used to filter the most critical item (component) failures before detailed maintenance decisions are made.

The RCMCost Module provides interactive graphical facilities for constructing a location hierarchy diagram representing the logical connection between the sub-systems and equipments constituting the overall plant or system. This diagram may be extended to represent critical functions, their functional failures and their causes (engineering failure modes). System effects are identified which contribute to outage and operational costs as well as safety and environmental risks. The relative severity of different effects is specified by the user. This structured method for identifying failure modes and linking them with their effects on the system is known as Failure Mode Effects and Criticality Analysis (FMECA) and is a powerful analysis process in its own right. RCMCost allows flexible user-defined reports to be produced highlighting the most important contributors to operational costs and safety and environmental risks.

Failure data, maintenance parameters, spares information and maintenance labor details are all stored in an AWB project. This data is used to provide advisory information based on simulation models incorporated in the program. For example, different maintenance intervals may be compared for their effect on maintenance and operational costs. The user may then record the decision on which maintenance policy (if any) to adopt. This decision may include combinations of:

- Scheduled Planned Maintenance Tasks
- Condition Monitoring Alarms
- On-Condition Inspections (predictive maintenance)
- Inspections for Hidden Failures
- Commissioning Periods
- Re-Design

The RCMCost module will automatically advise the user on the overall cost, safety and environmental benefits of adopting a particular maintenance policy based on the data provided by the user. The program's flexible report facility allows RCM worksheets to be produced identifying the user's decisions.

Once the maintenance policy has been decided for all the critical system components the RCMCost module will provide predicted spares requirements, maintenance labor manning levels, system costs and operational performance data.

As new data is gathered during the plant lifetime, or system design changes are made, RCM related data may be easily modified and maintenance procedures may be adjusted to reflect the living status of the plant.

Standards Support and Decision Diagrams

AWB supports RCM standards such as SAE JA1011, MSG-3 and MIL-STD-2173(AS) by providing a structured method for entering FMECA data and simulating the effects of different maintenance strategies on cost, safety, the environment and operational issues. The RCM decision making process is therefore substantially enhanced by the ability to quickly simulate the effects of preventive tasks, inspection tasks and condition monitoring taking into account ageing, hidden failures, maintenance labor costs, spares costs and availability. RCM decision diagrams are utilized in MSG-3 and MIL-STD-2173(AS) to provide a logical process for workgroups to determine what type of maintenance strategy to adopt for a given failure cause. The diagrams ask questions that often require analysis before a conclusion may be reached. In addition these diagrams follow a sequential process that may not be appropriate in identifying the optimal task or combinations of tasks for a given failure cause. However, AWB provides the full flexibility required to allow users to quickly compare the effects of different practical maintenance strategies and condition monitoring using well-known scientific methods.

AWB may be used to produce reports complying to the SAE JA1011, MSG-3 and MIL-STD-2173(AS) standards. Reports may contain FMECA data, maintainability data and RCM decision data.

Introduction to the AvSim Module

The AvSim module of Availability Workbench (AWB) enables users to simulate the performance of their systems as a whole taking into account dependencies between the individual components. By simulating how a system will perform, users can determine the effects of design and operational changes, and hence optimize system performance. Whereas the RCMCost module may be used to optimize scheduled maintenance policy and intervals, the AvSim module may be used to predict overall system performance, optimize spare holdings, investigate the effects of design changes and operational configurations.

In order to simulate the availability performance of a system the program needs to know how individual equipment failures combine with other failures to reduce throughput, create hazards and affect system operational capabilities. This is done by constructing a RBD or fault tree diagram that represents how combinations of events (usually failures) interact to affect the system. The AvSim module of AWB allows you to quickly construct these diagrams through any number of indenture levels. These diagrams can represent standby and voting arrangements, phase-dependent configuration changes, switching logic and buffer facilities.

Failure and maintenance models may then be defined and attached to historical data using Weibull sets. Also, consequences may be defined indicating the financial, safety, environmental and operational effects of loss of availability or throughput.

Once this has been done, AWB can produce a full system availability simulation building a picture of how the system will perform though its lifetime. Special optimization facilities are provided for optimizing spare holdings and users can try out different design and operational models to reduce life cycle costs.

Some of the capabilities of the AvSim module are summarized below:

- Interactive construction of RBD or fault tree diagrams
- Sub-system blocks, allowing automatic RBD pagination
- Pagination facilities for large fault trees
- Append projects created by different users using libraries
- Hyperlinks to external application in RBD and fault tree diagrams
- Data verification and model checks
- Simulation ‘Watch’ facility for checking your system and spares echelon models
- Multiple-system spares tracking for fleet modelling
- Simulation of production capacity levels with target cost penalties
- Standby sub-systems modelled
- Modelling of spares dependencies and stock levels
- Models recycling of spares via a repair shop
- Spares optimization facilities provided
- Batch ordering of spares with discounting
- Modelling of maintenance queuing
- Switching delays modelled
- Buffers modelled with depletion rates dependent on capacity requirement
- Opportunistic maintenance and 'hold for repair' modelling
- Models ageing and effectiveness of planned maintenance
- Extended outage penalty costs modelled
- Models financial, safety, operational and environmental consequences
- Models changing RBD and fault tree configurations during different phases
- Allows the modelling of different phase groups
- Phased time profiles
- NOT logic capability
- Importance rankings for spares
- Spare volume and weight calculations
- Statistical error indicators
- Record simulation details to file for external data processing

Introduction to the Life Cycle Cost Module

The Life Cycle Cost (LCC) module of Availability Workbench allows users to build a hierarchical cost breakdown structure (CBS) through an unlimited number of indenture levels. The CBS may be directly linked to cost predictions produced by the RCMCost or AvSim modules. Other costs may be defined as time-dependent cost equations or simple numerical values. Global variables may be defined and utilized in the cost equations.

High level costs are determined either by summating the cost values for child nodes in the CBS or by applying a user-defined cost equation. The syntax of cost equations is easy to understand and the construction of cost equations is assisted by an intelligent code-recognition utility that automatically reveals global variable lists as the user types in an equation.

Phase-dependent cost equations may also be defined. Phases are shared between the LCC and AvSim modules.

In summary the LCC module allows users to define life cycle costs other than those predicted by the RCMCost and AvSim modules. These costs may be integrated with predicted costs in the LCC cost breakdown structure to provide a time-dependent analysis of a system's whole life cycle cost process.

Introduction to the Weibull Module

The Weibull module of Availability Workbench (AWB) analyzes historical failure data by assigning probability distributions that represent the failure characteristics of a given failure mode. The failure distribution assigned to a given set of times to failure (known as a Weibull set) may then be assigned to causes in the RCMCost location hierarchy diagram or failure models in the AvSim module. Assigning failure distributions to historical data in this way enables the AWB simulation engine to emulate the effects of failures on systems. Historical data is usually extracted from the Computerized Maintenance Management System (CMMS) or Failure Reporting and Corrective Action System (FRACAS) database using the AWB import or Dynamic Link Library (DLL) facilities. The failure distribution assigned to a given set of times to failure (known as a Weibull set) may be assigned to failure models that are attached to causes in a RCM location hierarchy, blocks in a reliability block diagram or events in a fault tree diagram.

Weibull sets may also represent collections of actual historical repair times for a given task. The Weibull module can assign distributions that represent possible fluctuations in repair times. Repair Weibull sets can be assigned to tasks associated with causes in the RCMCost module or failure models in the AvSim module.

The historical times in a failure Weibull set will represent the age of an equipment at the point of its first failure. Times in a repair Weibull set represent the time it takes to repair an equipment.

In summary, the Weibull module of AWB analyzes sets of historical data and assigns appropriate distributions for use in simulations by the RCMCost and AvSim modules.

The Weibull Analysis Module analyzes historical data using the following distributions:

- Exponential Distribution
- 1-Parameter Weibull Distribution
- 2-Parameter Weibull Distribution
- 3-Parameter Weibull Distribution
- Bi-Weibull
- Tri-Weibull
- Lognormal Distribution
- Normal Distribution
- Weibayes
- Phased Bi-Weibull
- Phased Tri-Weibull

AWB automatically fits the selected distribution to the data provided and displays the results graphically in the form of cumulative probability plots, failure rate plots and probability density function plots.

Data may be entered manually by the user or imported from other packages or transferred via the Windows clipboard.

New data can be analyzed and assigned in 3 simple steps:

- Enter or import the data
- Select a distribution type
- Assign the Weibull Set to the appropriate causes in the RCMCost module or the failure models in the AvSim module

Introduction to the Process Reliability Module

The Process Reliability module allows users to analyze daily production data using Weibull analysis plots. These plots identify systematic and reliability losses by recognizing trends in the production data. Nameplate production ratings may be specified (similar to concepts originating from six-sigma methodology) and compared with demonstrated production data. Losses can therefore be identified for corrective action.

The Process Reliability module allows production data to be compared from different plants or different time periods. Production data may also be transferred from simulated production profiles created from within the AvSim module. This allows production data from potential plant improvements to be compared with existing production data.

The Availability Workbench Simulation Engine

The Availability Workbench (AWB) simulation engine employs Monte Carlo simulation methods to estimate system and sub-system parameters such as unavailability, number of expected failures, production capacity and costs. The process involves synthesizing system performance over a given number of simulation runs. Each simulation run in effect emulates how the system might perform in real life, based on the input data provided by the user. The input data can be divided into two categories - a failure logic diagram and quantitative failure and maintenance parameters. The logic diagram (either a fault tree or a reliability block diagram in the case of the AvSim module or a location hierarchy in the case of the RCMCost module) informs the computer program how component failures interact to cause system failures. The failure and maintenance parameters inform the program how often components are likely to fail and how quickly they will be restored to service. By performing many simulation runs, the computer program can build up a statistical picture of the system performance by recording the results of each run.

Monte Carlo Simulation must emulate the chance variations that will affect system performance in real life. To do this, the computer program must generate random numbers, which form a uniform distribution. AWB uses the Microsoft run-time library to generate pseudo random numbers.

As an example of how simulation works, consider the following example. Suppose we wish to determine the unreliability of a complex system over a period of 1 year. A simulation model of the system could be developed which emulates the random failures and repair times of the components in the system. The model might be run over the system lifetime of 1 year 1000 times and each time a component fails the model determines whether the system has failed. If the system does not survive on 65 of the lifetime simulations then the system unreliability, *F(1)* , could be estimated as

$$F(1) = \frac{65}{1000} = 0.065$$

Simulation methods are generally employed in reliability studies when deterministic methods are not capable of modelling strong dependencies between failures. In addition, simulation can readily handle the reliability behavior of repairable components with non-constant failure or repair rates.

For example, the simple expression

$$Q(t) = \frac{\lambda}{\lambda + \mu}\left(1 - e^{-(\lambda+\mu)t}\right)$$

may be used to determine the unavailability, *Q*, of a single component at time *t* where

λ = constant failure rate
μ = constant repair rate

This expression assumes that the failure and repair of the component is independent of the state of any other component in the system. This may not be the case if the component is in standby to another component (where the standby failure rate is less than the operating failure rate). In addition, the component may be influenced by other external factors such as the availability of spares and labor to perform scheduled and corrective maintenance. The component's reliability behavior may also change during different operational phases. In addition, if it is a mechanical component, its failure rate may increase with time (ageing) and therefore the simple expression above inaccurately represents the behavior of the component.

By using simulation methods, AWB is not restricted to handling only independent component failures and repairs and can easily model dependencies on spares, labor and operational phases. In addition, the Weibull failure distribution may be used to handle ageing components.

New Features for Version 2.0

New Features for Version 2.0 Overview

Version 2 represents a major new development of the widely used Availability Workbench program incorporating Isograph's leading-edge RCMCost and AvSim products into a single powerful integrated environment for RCM and system availability simulation.

Developed for Microsoft's latest .Net framework it provides all the rich graphical user interface features you would expect for a modern application. The new Report Designer provides additional features such as PDF file creation. Projects may now be stored in compressed or XML format and benefit from automatic data validation routines. The Maximo Portal has been substantially enhanced allowing users to upload PMs and resources using a variety of different schemes. A task library facility has been added enabling generic tasks to be quickly located and copied into the current project. Weibull distributions may now be automatically selected using a best-fit criteria.

Enterprise Version

One of the major advances is the introduction of the Enterprise Version. Organizations may now install a centralized database system containing project and libraries in a controlled environment with user groups and roles. Licensed enterprise users may check projects in and out of the enterprise system and access centralized libraries and parts data for which they have the appropriate permissions. Enterprise administrators may implement project versions where appropriate.

Enterprise System

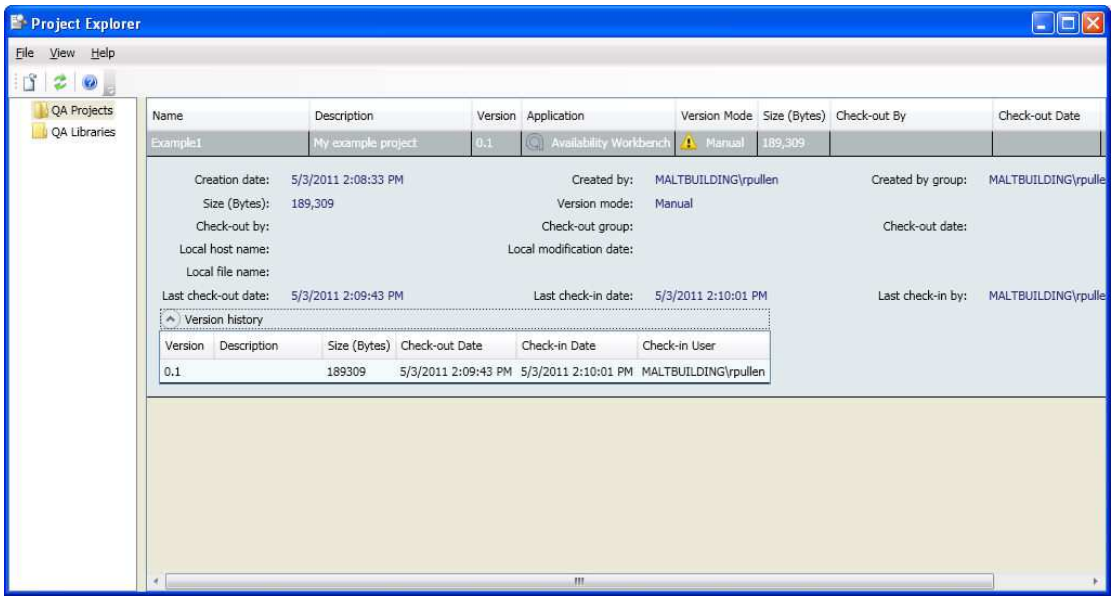
One of the major new features for version 2 is the introduction of the Enterprise System. Organizations may now install a centralized database system containing project and libraries in a controlled environment with user groups and roles. Licensed enterprise users may check projects in and out of the enterprise system and access centralized libraries for which they have the appropriate permissions. Enterprise administrators may implement project versions where appropriate.

The Enterprise System Server requires the following:

- Net Framework 4.0 Full
- SQL Server 2005 or SQL Server 2008
-

All versions of SQL Server 2005 and SQL Server 2008 are supported including the Express editions. It is strongly recommended that the optional Management Studio is installed for all the Express editions.

AWB client applications may access an installed Enterprise System if they have an Enterprise license. Users will be able to check out a project for modification so long as they have the necessary permissions and later check the project back in to the system. If they are disconnected from the network for any reason they may check in a project at a later date. Libraries may be opened for copying data into projects or checked-out for modification. Administrators may upload non-enterprise projects into an Enterprise system and set up new projects with or without version control.



Checking Out a Project from the Enterprise System

Compressed Project Files

Project and library data is saved to file in compressed or XML format. You can set your format preference in the **Files** tab of the Application Options dialog. Compressed files are created with the extension '.awb' whereas XML files are created with the extension '.awbx'. XML projects and libraries may be significantly larger then the equivalent compressed file format.

New Features for the Report Designer

Report wizard

The report wizard allows the user to quickly create text column, text row, graph or diagram reports. The user can preview the report design as they proceed through each page the of the wizard.

Adobe PDF export

All report types can be published in Adobe PDF (Portable Document Format) to file. The user can select either a quick publishing mode (using the current settings) or a normal mode allowing them to specify PDF generation settings.

Report folder report type

Report folder reports display one or more text column, text row, graph or diagram reports in a single report. When a report folder report is opened in print preview mode the page numbering is continuous from 1 to the total number of pages in the constituent reports.

Pie charts

A pie chart style has been added to the graph report type. The pie chart properties include:

- Data label and value positioned either as: inner radial, inner horizontal or outer horizontal
- Detailed data label and value properties (font, color, border, margins etcetera)
- Detailed pie title properties (font, color, border, margins etc.)

Panel editor

The panel editor allows rapid editing of report element properties. When a report element is selected the panel editor is displayed with the element's properties. Changes to the element's properties are saved when a new report element is selected or the panel editor **Apply** button is selected.

User queries

Text column, text row and graph reports allow the user to select a standard query or specify their own custom query. The user query extends this facility to allow the user to create their own named pre-defined custom queries for a host application. The user queries are selected by name in the report query selection controls in a similar manner to the standard queries. User queries can be exported for use by co-workers, with an import facility provided for import of exported queries.

Design mode and reading mode

A reading mode has been introduced. Selection of the **Reading Mode** option hides the outline tree and the panel editor and switches the report to read-only mode. In addition the menu bar and standard toolbars are hidden and a special reading mode toolbar displayed. The purpose of reading mode is to maximize the area of the screen available for the actual report display.

Automatic selection of graph axis type

When graph report data group variables are selected the associated axis type is switched to match the data type of the variable. For example if the variable data type is text the axis type will be switched to label, if the variable type is numeric the axis type will be switched to value.

Filter Not operator added

A Not operator has been added to the column filter in text column reports and the X, Y and X variables filters for data groups in graph reports.

Filter Like automatic wildcard operator added

A **Like automatic wildcard** operator has been added to the column filter in text column reports, the group and detail heading filter in text row reports and the X, Y and X variables filters for data groups in graph reports. This operator automatically adds % before and after the operand for the **Like** operator.

Show on First Page and Show on Last Page properties

Show on First Page and **Show on Last Page** properties have been added to text boxes and pictures. Text boxes and pictures with this property will be shown on the specified page regardless of the **Show On** property (even, odd or all pages)

Multiple selected diagram categories with category page ordering

One or more diagram categories (up to the number available for the product) can be selected for a diagram report. In addition the category order can be specified for when the report is displayed in print preview mode. Previously only one or all categories could be selected and no page ordering was available.

Go to page control added to the print preview toolbar

A page number control has been added to the print preview toolbar allowing the user to enter a page number to skip to when in print preview mode.

ANSI (Latin) or Unicode encoding for export to text file formats

ANSI (Latin) or Unicode encoding can be specified explicitly when exporting to the various text formats. It can sometimes be necessary to specify the format when exporting to Excel in some locales.

Report elements generated from a report template are now locked for editing

Report elements generated from an applied report template are now locked to prevent editing. They are also displayed with a light blue shading.

Improved status message display

The status bar now alerts the user to new messages by displaying them in a temporary balloon to attract the user's attention. In addition the user can specify that a message beep is sounded when various message types are displayed.

Improved SQL query parsing

The SQL query parsing has been improved so that tables names in complex queries are now recognized. This resolves a problem whereby data would not be generated for a SQL query by the host application.

New Features for the SAP Portal

The SAP Portal download functionality has been enhanced to facilitate the download of BOMs, including the associated PM assemblies through the functional location hierarchy. Users may now simply select the functional location hierarchy and connected equipment, location and material BOMs for download to AWB.

In addition, the download of SAP operations to RCMCost tasks has been speeded up by introducing a Next button in the Maintenance Plan dialog used for download. This provides users with the facility of selecting a batch of SAP maintenance items within the location hierarchy for download rather than selecting them individually. Also users now have the option to download SAP operations to AWB tasks in one single action (all operations are download to each cause) and then delete inappropriate associations of tasks to causes from within the RCMCost module.

New Features for the Maximo Portal

The Maximo Portal has been substantially enhanced to allow the download of additional data types such as spares and tools and the upload of a greater variety of maintenance plan schemes.

Master Data Download

Users may now download failure causes as well as the problem codes within a failure class. This allows a more refined identification of work order failures in the **Analytics** tab and the ability to including failure causes when downloading asset information from Maximo into the RCMCost module of AWB.

Spares and BOMs may now also be downloaded together with equipment (tools).

PM Upload

The **PM Upload** tab of the MAXIMO Portal now enables users to upload PMs using one of the following upload schemes:

- Map RCMCost task to Maximo job task
- Map RCMCost task to Maximo route stop
- Map RCMCost task to Maximo job sequence

Users may also upload a PM hierarchy and populate Maximo job tasks using the notes fields of a RCMCost task.

Task Library

The task library facility allows users to build libraries of common tasks and search, filter and copy these tasks into RCMCost causes and AvSim failure models. Library tasks may be filtered using the RCMCost location and AvSim failure model hierarchy structures. Alternatively they may be filtered using the task group and task group type hierarchical structure.

A task library is similar in concept to any other Availability Workbench library. You may build a task library simply by adding tasks to RCMCost causes or AvSim failure models in the normal way (by adding tasks using the **Maintenance** tab of the **Cause Properties** or **Failure Model Properties** dialogs). Existing projects may also be attached as libraries and all the defined tasks will be available to copy into the current project.

Library tasks may be copied to an existing project by selecting the **Copy Tasks From Library** button in the **Maintenance** tab of the **Cause Properties** or **Failure Model Properties** dialogs. You may also copy tasks from within the current project rather than from an attached library. When tasks are copied from an attached library the associated resources (labor, equipment and spares) are also copied across if they do not already exist in the project.

Automatic Selection of Weibull Distributions

A new analysis option has been added to the Weibull module for automatically determining the 'best fit' distribution for the data items associated with the Weibull set. AWB will perform a parameter fit for all the available distributions and select the distribution and associated parameters that provide the smallest goodness of fit indicator.

AWB calculates the goodness of fit indicator using the following expression

$$\varepsilon = \sqrt{\frac{\sum_{i=1}^{N} (y_i - \hat{y}_i)^2}{N}}$$

where y_i and $\hat{y}_i$ are the fitted unreliability values and estimated unreliability point values respectively. N is the total number of points plotted.

New Process Reliability Module

A new Process Reliability module has been added to Availability Workbench. The module allows users to analyze daily production data using Weibull analysis plots. These plots identify systematic and reliability losses by recognizing trends in the production data. Nameplate production ratings may be specified (similar to concepts originating from six-sigma methodology) and compared with demonstrated production data. Losses can therefore be identified for corrective action.

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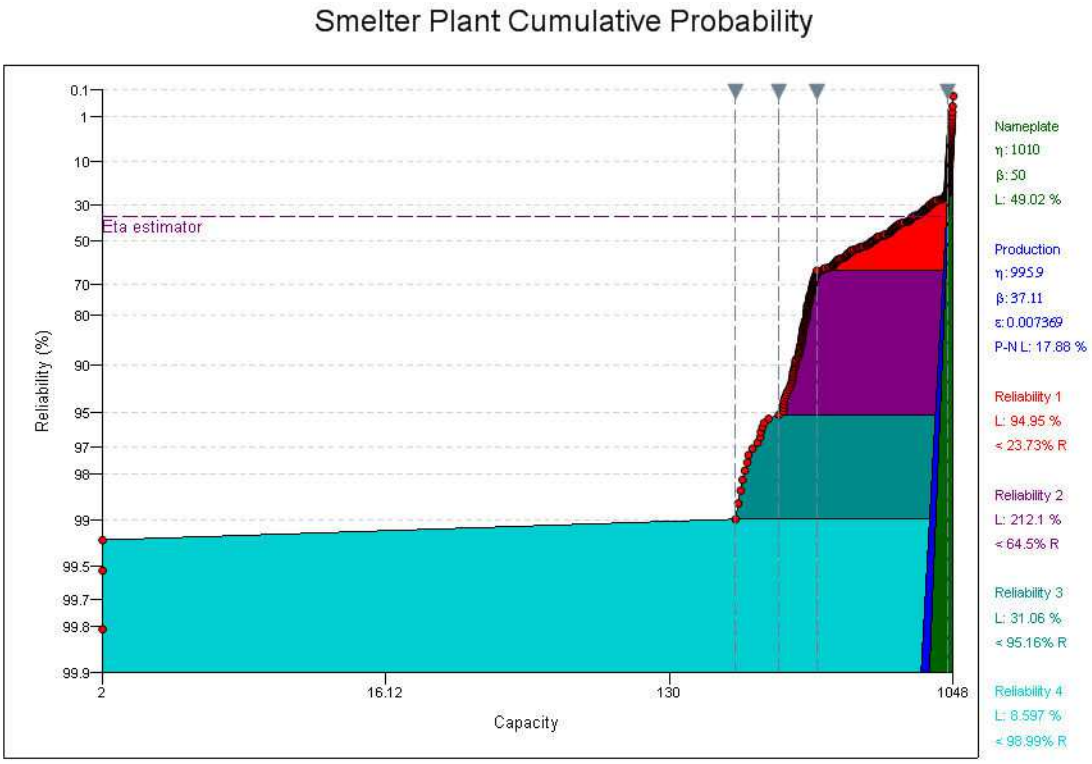


New Features for the DLL

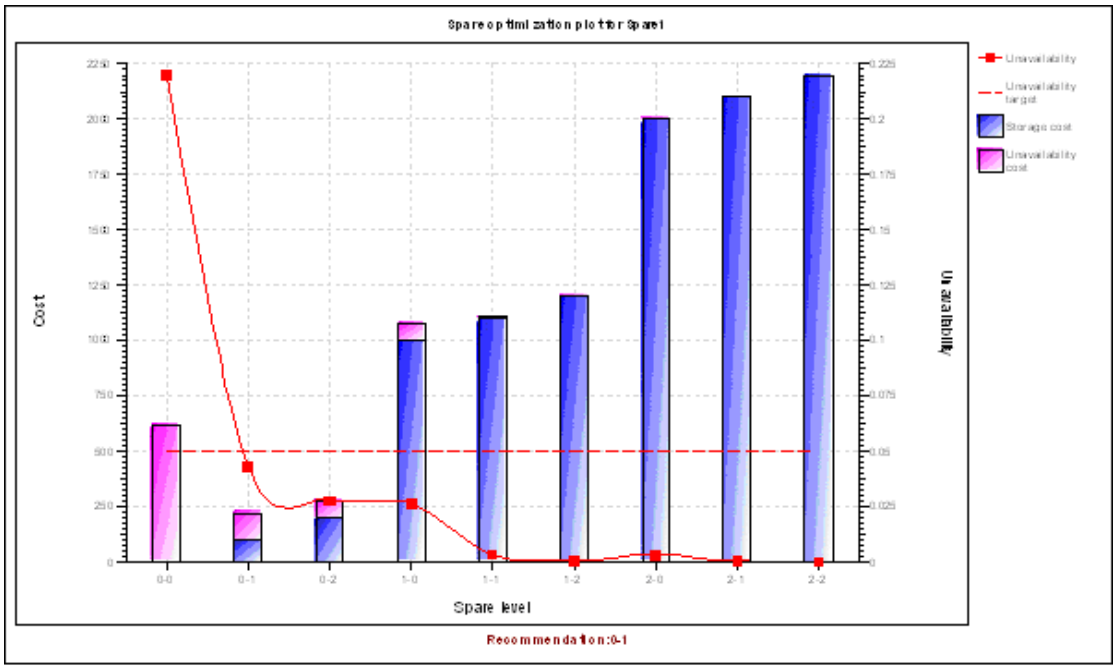
The AWB Dynamic Link Library (DLL) has been extended to provide the functionality to analyze project data programmatically. This allows programmers to build or modify an AWB project, request AWB to analyze the project, and then display or save the analysis results. The analysis functionality applies to RCMCost system simulations and task or task group optimizations. It also provides the functionality to perform AvSim simulations, Weibull, Process Reliability and LCC analyses. Methods are also provided for providing progress messages during simulations.

New Features for Version 2.1

New Features for Version 2.1 Overview

Spares Optimization for RCMCost Module

A spares optimization facility has now been added to the RCMCost module. Users may now request the program to simulate and compare costs for different spares holding levels. The cost of spare storage is weighed against the cost of spare supply delays to provide a recommendation for the optimum spare holding. Users may also request the recommended spare holding policy to meet an unavailability target.



Plot showing simulated costs and spare unavailability values for different holding levels

Plugins

If you are licensed to use the new Plugins facility you will be able to create programmable plugins that read, analyze and modify data from the current AWB project. Plugins may be used to create specialized reports, perform specialized operations or conversions, modify project data and call external libraries or processes. A plugin may be exported for use by other users.

Advances in the DLL (API)

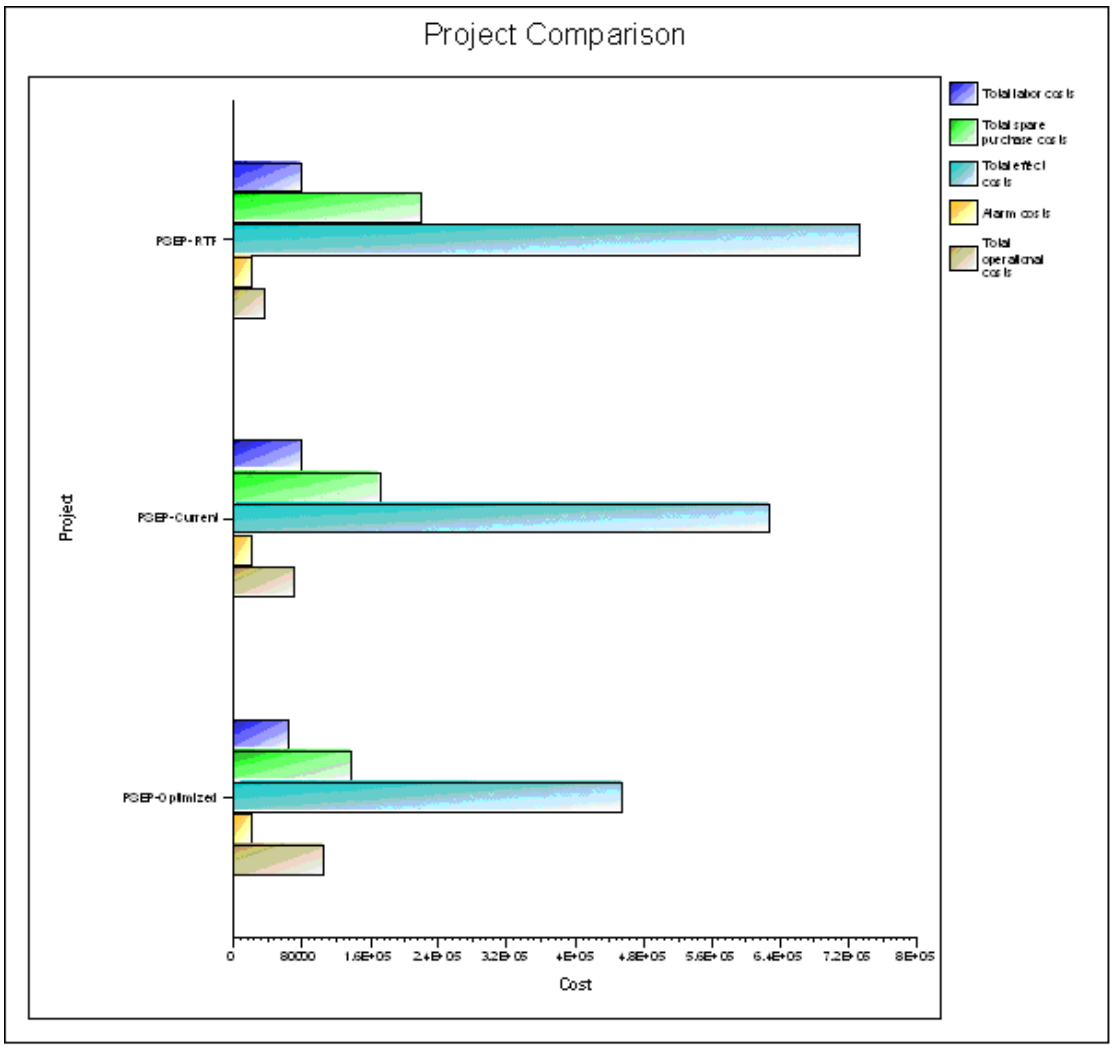
The Dynamic Link Library facility now provides the functionality to access Enterprise System projects. Users can also build URL strings identifying individual objects within an AWB project.

Excel/Access 2007

Excel/Access 2007 file formats are now supported together with 2003 versions.

Project Comparison Plots

Project comparison plots are now available in both the RCMCost and AvSim modules. Simulated system costs may be compared for different projects simply by attaching multiple projects using the Library facility.



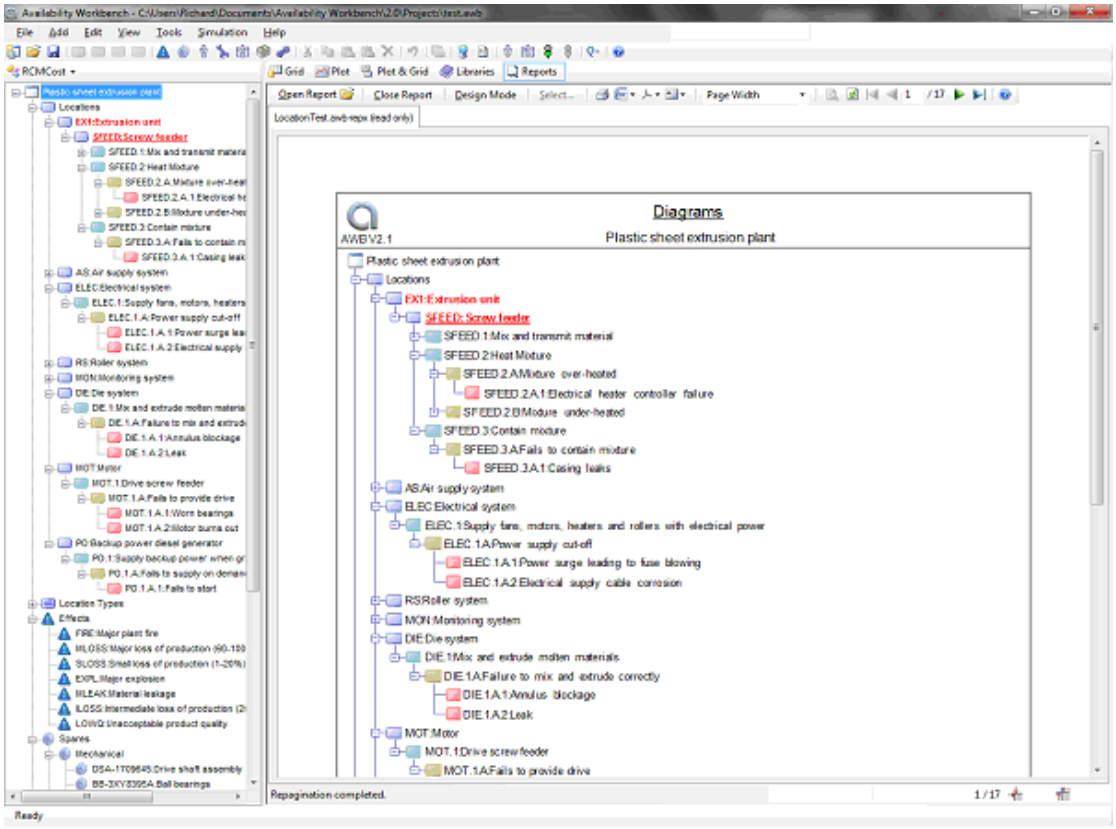
Plot comparing simulated whole plant costs for 'Run-to-Failure', 'Current' and 'Optimized' maintenance strategies

RWB Project Conversion

RWB project files may now be imported into AWB. Conversions between model formats are made automatically.

Project Tree Diagram Reports

A diagram of the current project tree may now be displayed in a diagram report. Diagram reports are automatically paginated.



Previewing a Project Tree Diagram Report

SAP Portal Enhancement

The SAP Portal has been enhanced to allow the upload of user-specified maintenance plan categories for maintenance and service orders. New download filter options have also been added.

Maximo Portal Enhancement

The efficiency of the Maximo Portal download facility has been enhanced and new filters provided for functional location downloads.

Enterprise Project Differencing

The Isograph Enterprise System now provides a powerful project differencing facility that allows a user to display and report the differences between two or more selected project versions.

Enterprise Reporting

Enterprise users may now produce reports listing project, library and version data.

Other Changes…

- License dialogs are no longer displayed when using AWB as an assembly (DLL)
- Setting a safety, operational or environmental target to zero now removes the requirement to meet the target from optimization calculations
- Safety, criticality and environmental target lines may now be removed from optimization plots
- SAP portal uploads of functional locations now allow the upload of a non-existing function to an existing function
- Hyperlink browse file filters now include Office 2007 extensions
- A remove input option has been added to the diagram menu for fault tree diagrams
- GUID fields have been added for all primary objects
- Ctrl+S shortcut key added for **Save Project** menu option
- Portal download of work orders to Weibull sets now allows new items to be added to existing Weibull sets

- Weibull eta values for tasks now also populate the task duration field to ensure consistency in calculations
- Enterprise menu options have been extended to allow better local save control. Users may now view previous versions of an enterprise project. Project names are now displayed in the main window header rather than the ID.

Licensing

Overview of Licensing

If you have purchased a copy of Availability Workbench (or are evaluating Availability Workbench) you will receive an **Entitlement Certificate** by email containing your **Activation ID**. Depending on the license type you have requested, this **Activation ID** will either activate a standalone Availability Workbench license or activate a 'floating' license on a license server. The 'floating' license option allows one or more users (depending on how many copies you have purchased) on one or more client machines to obtain an Availability Workbench license from the license server.

The **Activation ID** is entered in either the Availability Workbench program itself (for a standalone license) or in the **License Server Activation** program (for a license server license). The license is activated by connecting via the Internet to the **Isograph License Activation Service**. If an Internet connection is not available the license is activated by sending a request file to Isograph by email and then processing a response file received by a return email.

Note that activation over the Internet requires port 80 to be open in your firewall.

The license information is held on the local file system of the standalone or license server machine. The location where this is held is called **Trusted Storage**. This term is not normally of interest to the user, but you may see it displayed in status information.

Availability Workbench may also be licensed using a hardware key. Hardware keys can only license the program in standalone mode. If you have purchased a hardware key then you simply need to plug the key into a USB port on your computer and set the license type to **Hardware key** in the **License Configuration** dialog within the Availability Workbench program.

Demonstration Mode

Availability Workbench will run in demonstration mode unless you are licensed to run an unrestricted version of the software.

When running in demonstration mode the user is strictly limited in the number of objects that may be analyzed in a project (limits are displayed in the About Availability Workbench dialog). Each session is limited to 4 hours and users are prevented from saving or exporting data.

However, if you have purchased an Availability Workbench license you should proceed to the License Configuration dialog by selecting the **Tools, License Configuration** pull-down menu option. If the **Demonstration** dialog is currently displayed you may proceed directly to this dialog by selecting the **License** button. Once you are licensed for a particular module, the restrictions for that module will be removed.

If the demonstration mode is too restrictive for you to evaluate the software sufficiently, you may apply for a time-limited evaluation license by contacting Isograph at license@isograph.com (USA) or licence@isograph.com (Rest of the world).

License Configuration

You may set your license configuration using the **License Configuration** dialog. This dialog is accessed by selecting the **Tools, License Configuration** pull-down menu option or by selecting the **License** button in the **Demonstration** dialog.

License Type

There are three license types available. These types are:

- Standalone
- Server
- Hardware key
- Server (No trusted storage service)

The **Standalone** and **Server** license types use software protection methods to restrict the number of users of any Availability Workbench (AWB) module according to the license you have purchased. The **Hardware key** type uses a USB hardware device (commonly known as a dongle) to provide protection. Select the license type you have purchased. Then follow the instructions below according to your license type.

Select the **Server (No trusted storage service)** option if you have installed the Availability Workbench client using the 'no trusted storage service' installation. This installation does not install the service that supports standalone licenses stored in local trusted storage. Selecting this mode prevents the checks for Availability Workbench standalone licenses from running. Note also that when operating in this mode the borrowing functionality is disabled.

Activating a Standalone License

Before activating a standalone license you will need your **Activation ID**. This identifier is sent to you (normally by email) after you have purchased a license. You can then activate the standalone license from within the AWB program by selecting the **Standalone** license type and then selecting the **Activate** button in the **License Configuration** dialog. The **Application License Activation** dialog will then appear.

Activating using the Web (Recommended)

If your computer is connected to the Web you can simply copy your **Activation ID** to the appropriate field and select the **Activate** button. AWB will then automatically update your license. You can then exit the license dialogs. You will need to exit and re-start AWB for the existing restrictions to be removed.

Note that activation over the Internet requires port 80 to be open in your firewall.

Activating using Files

If your computer is not connected to the Web you can obtain the license using files. To do this select the **File** sub-tab underneath the **Activate License** tab of the **Application License Activation** dialog. First you will need to send Isograph a request file. To do this use the **Browse** button opposite the **Request file** field to specify a suitable file location and name for the file to be created. Then select the **Generate** button. AWB will then create the file in the location you specified. Send this file to Isograph. Once this file is received by Isograph we will return a response file. Copy this file to your computer and then use the **Browse** button opposite the **Response file** field to specify the file's name and location. Then select the **Process** button. AWB will then update your license. You can then exit the license dialogs. You will need to exit and re-start AWB for the existing restrictions to be removed.

Activating using Short Codes

If your computer is not connected to the Web and you are not allowed to remove files from your system then you can obtain the license using the short code method. To do this select the **Short Code** sub-tab underneath the **Activate License** tab of the **Application License Activation** dialog. If you have requested activation by short code from Isograph you will have received an ASR file in addition to your Activation ID. First copy this file to your system and then select the ASR file **Browse** button to select this file. Next select the **Generate** button to generate the Short Code. Send this Short Code by e-mail to Isograph. You will receive a Response Code by return e-mail. Copy this code to the **Response code** text box. Select the **Process** button to activate

the license. The status of the activation process will be displayed in the lower status area. You can then exit the license dialogs. You will need to exit and re-start AWB for the existing restrictions to be removed.

Connecting to an Existing License Server

If you already have a license server installed on the network then you can connect to the server by providing the host name or IP address of the server.

To connect to a license server first select the **Server** license type. Then type in the host name or IP address of the server into the appropriate field in the **License Configuration** dialog. If the default port is not being used for the connection un-check the **Use default port** check box and specify the port number in the appropriate field.

Then select **OK** to exit the license dialog. You will need to exit and re-start AWB for the existing restrictions to be removed.

Returning a Standalone License

You may return a standalone license and reactivate the license (using the same **Activation ID**) on a different machine so long as your license agreement permits you to do this.

Note: Your license agreement restricts the number of times you can return a license in a year.

Returning a Standalone License using the Web (Recommended)

If your computer is connected to the Web you can return a license by selecting the **Return** button in the **License Configuration** dialog. The **Application License Activation** dialog will then appear. Simply select the license to be returned and then select the **Return** button. Availability Workbench will automatically shut-down 30 minutes after returning a license so you should first save your project data.

Returning a Standalone License using Files

If your computer is not connected to the Web you can return a license using files. To do this select the **File** sub-tab underneath the **Return License** tab of the **Application License Activation** dialog. First you will need to send Isograph a request file. To do this use the **Browse** button opposite the **Request file** field to specify a suitable file location and name for the file to be created. Then select the **Generate** button. AWB will then create the file in the location you specified. Send this file to Isograph. Once this file is received by Isograph we will return a response file. Copy this file to your computer and then use the **Browse** button opposite the **Response file** field to specify the file name and location. Then select the **Process** button. AWB will then return your license. Availability Workbench will automatically shut-down 30 minutes after returning a license so you should save your project data before returning a license.

Returning a Standalone License using Short Codes

If you have activated a license using the short code method then it must be returned using the short code return method. To do this select the **Short Code** sub-tab underneath the **Return License** tab of the **Application License Activation** dialog. Select a single license to return from the list view. Next select the **Browse** button select the ASR file received when you activated the license. Select the **Generate** button to generate the Short Code in the **Short code** text box. Send this Short Code by e-mail to license@isograph.com. You will receive a Response Code by return e-mail. Copy this code to the **Response code** text box. Select the **Process** button to de-activate the license. The status of the de-activation process will be displayed in the lower status area.

Repairing a Standalone License

It is unlikely that you should ever need to repair a license. However, in rare circumstances this may be necessary.

Repairing a Standalone License using the Web (Recommended)

If your computer is connected to the Web you can repair a license by selecting the **Repair** button in the **License Configuration** dialog. The **Application License Activation** dialog will then appear. Simply select the license to be repaired and then select the **Repair** button.

Repairing a Standalone License using Files

If your computer is not connected to the Web you can repair a license using files. To do this select the **File** sub-tab underneath the **Repair License** tab of the **Application License Activation** dialog. First you will need to send Isograph a request file. To do this use the **Browse** button opposite the **Request file** field to specify a suitable file location and name for the file to be created. Then select the **Generate** button. AWB will then create the file in the location you specified. Send this file to Isograph. Once this file is received by Isograph we will return a response file. Copy this file to your computer and then use the **Browse** button opposite the **Response file** field to specify the file name and location. Then select the **Process** button. AWB will then repair your license.

Repairing a Standalone License using Short Codes

If you have activated a license using the short code method then it must be repaired using the short code repair method. To do this select the **Short Code** sub-tab underneath the **Repair License** tab of the **Application License Activation** dialog. Select the license to repair from the list view. Next select the **Browse** button select the ASR file received when you activated the license. Select the **Generate** button to generate the Short Code in the **Short code** text box. Send this Short Code by e-mail to license@isograph.com. You will receive a Response Code by return e-mail. Copy this code to the Response code text box. Select the Process button to repair the license. The status of the repair process will be displayed in the lower status area.

Borrowing a Server License

Note: Your license agreement may restrict your borrowing capabilities.

You may borrow licenses if you have a server license and your license agreement permits borrowing. A borrowed license acts like a standalone license and allows users to run Availability Workbench whilst disconnected from the network. Licenses are borrowed for a period of time. Once the borrowing period expires the borrowed license will be automatically returned to the license server. Borrowed licenses may be returned to the license server before the automatic expiration date if required.

To borrow a license you must first ensure that you are connected to an existing license server. Instructions on how to do this are given above. Then select the **Borrow** button in the **License Configuration** dialog. The **License Borrowing** dialog will then appear. To borrow a license enter your server license **Activation ID** in the appropriate field, specify the borrowing expiration date and then select the **Borrow** button. If you wish to return a borrowed license before the expiration date select the **Return** button in the **Server license location** area of the **License Configuration** dialog. Then select the license you wish to return from the list followed by selection of the **Return** button.

After borrowing a license you will need to exit and restart the program for the license to become effective.

When using borrowed licenses you should not change the license type or the license server settings. Availability Workbench will automatically recognize the borrowed license even if your computer is not connected to the license server.

Using the Application Configuration File to Specify the License Configuration

The **LicenseDisableUserSettings** value must be set to **True** in the Availability Workbench configuration file **AvailabilityWorkbench.exe.config** as an application setting if you wish to prevent a user from specifying the license type and connection strings from within the **License Configuration Dialog**:

```
<applicationSettings>
  <AvailabilityWorkbench.Properties.Settings>
    <setting name="LicenseDisableUserSettings" serializeAs="String">
      <value>True</value>
    </setting>
    <setting name="LicenseServerHostNameOrIPAddress" serializeAs="String">
      <value />
    </setting>
    <setting name="LicenseServerPortNumber" serializeAs="String">
      <value />
    </setting>
    <setting name="LicenseUseDefaultPortNumber" serializeAs="String">
      <value>True</value>
    </setting>
    <setting name="LicenseType" serializeAs="String">
```

```
        <value>Server</value>
      </setting>
    </AvailabilityWorkbench.Properties.Settings>
  </applicationSettings>
```

Checking Out Server Licenses

If your license configuration indicates a **Server** license type then Availability Workbench (AWB) will display the **License Check-Out** dialog on program start-up. This dialog displays the licenses available for your use during a program session.

Licenses

You can check-out the licenses you wish to use by selecting the appropriate licenses in the **Licenses** list. Once you have checked-out a license it will not be available for use by another user. Licenses will be automatically returned to the license server on program termination.

Licenses may be selected on a module basis. For example, let us suppose you have purchased 5 RCMCost module licenses, 3 AvSim module licenses and 3 Life Cycle Cost module licenses. If you check-out 1 RCMCost license and 1 AvSim license then 4 RCMCost, 2 AvSim and 3 Life Cycle Cost licenses will remain available to other users.

Users

Selection of the **Users** button in the **License Check-Out** dialog will reveal the **User Information** dialog. This dialog displays information on which users have checked-out licenses from the license server.

License Information

Selection of the **License Info** button in the **License Check-Out** dialog will reveal the **License Information** dialog. This dialog displays information about the available licenses on the license server.

License Server Activation

You may activate and return server licenses by selecting **Availability Workbench, License Server Activation** from the Windows **Start** menu. The **License Server Activation** dialog will then appear.

Activating a Server License

Before activating a server license you will need your **Activation ID**. This identifier is sent to you (normally by email) after you have purchased a license. You can then activate the server license by selecting the **Activate License** tab in the **License Server Activation** dialog.

Activating using the Web (Recommended)

If your computer is connected to the Web you can simply copy your **Activation ID** to the appropriate field and select the **Activate** button. Your license will then be automatically updated. You can then exit the **License Server Activation** dialog.

Note that activation over the Internet requires port 80 to be open in your firewall.

Activating using Files

If your computer is not connected to the Web you can obtain the license using files. To do this select the **File** sub-tab underneath the **Activate License** tab of the **License Server Activation** dialog. First you will need to send Isograph a request file. To do this use the **Browse** button opposite the **Request file** field to specify a suitable file location and name for the file to be created. Then select the **Generate** button. The file will then be created in the location you specified. Send this file to Isograph. Once this file is received by Isograph we will return a response file. Copy this file to your computer and then use the **Browse** button opposite the **Response file** field to specify the file's name and location. Then select the **Process** button. The server license will then be updated. You can then exit the **License Server Activation** dialog.

Starting the License Server

After activating your server license you must start up the Availability Workbench license server. Availability Workbench users will not be able to access activated server licenses until the license server has been started. To start-up the license server select **Availability Workbench, License Manager** from the Windows **Start** menu. The **LMTOOLS** dialog will appear. Navigate to the **Start/Stop/Reread** tab and select the **Start Server** button.

Returning a Server License

You may return a server license and reactivate the license (using the same **Activation ID**) on a different machine so long as your license agreement permits you to do this.

Note: Your license agreement restricts the number of times you can return a license in a year.

Before returning a license you must first stop the license server if it is running. To stop the license server select **Availability Workbench, License Manager** from the Windows **Start** menu. The **LMTOOLS** dialog will appear. Navigate to the **Start/Stop/Reread** tab and select the **Stop Server** button. You will then need to access the License Server Activation dialog by selecting **Availability Workbench, License Server Activation** from the Windows **Start** menu.

Returning a Server License using the Web (Recommended)

If your computer is connected to the Web you can return a license by navigating to the **Return License** tab in the **License Server Activation** dialog. Then select the license to be returned in the list before selecting the **Return** button.

Returning a Server License using Files

If your computer is not connected to the Web you can return a license using files. To do this select the **File** sub-tab underneath the **Return License** tab of the **License Server Activation** dialog. First you will need to send Isograph a request file. To do this use the **Browse** button opposite the **Request file** field to specify a suitable file location and name for the file to be created. Then select the **Generate** button. The file will then be created in the location you specified. Send this file to Isograph. Once this file is received by Isograph we will return a response file. Copy this file to your computer and then use the **Browse** button opposite the

Response file field to specify the file name and location. Then select the **Process** button. The license will then be returned.

Repairing a Server License

It is unlikely that you should ever need to repair a license. However, in rare circumstances this may be necessary.

Repairing a Server License using the Web (Recommended)

If your computer is connected to the Web you can return a license by navigating to the **Repair License** tab in the **License Server Activation** dialog. Then select the license to be repaired in the list before selecting the **Repair** button.

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