



**RiskMetrics Group**

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## CreditManager White Paper

September 2009

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## I. CreditManager Introduction

**CreditManager™** is an ASP-based or locally installed application that helps institutions measure, analyze and manage portfolio risk due to credit events. With RiskMetrics CreditMetrics™ as its foundation, CreditManager helps risk managers quantify overall credit risk by capturing market exposure, rating changes and default risks within a Value at Risk framework.

CreditManager helps institutions:

- Identify excessive risk concentrations and poorly performing exposures
- Determine the optimal level of participation in a new investment opportunities
- Investigate the least expensive means of reducing credit exposure on selected names
- Assess new trading strategies
- Perform cost-benefit analysis on proposed hedging programs

## II. Industry Standard Methodology

CreditManager is based upon RiskMetrics CreditMetrics™ methodology--considered a benchmark of credit risk measurement. CreditMetrics provides a **methodology** for assessing portfolio risk due to changes in debt value caused by changes in obligor credit quality.

CreditMetrics is a portfolio credit model. It takes information on exposures and underlying obligors as inputs. As output, it produces the distribution of values for the portfolio composed of the exposures at some fixed horizon in the future. From this distribution, it is possible to produce statistics which quantify the portfolio's absolute risk level, such as the standard deviation of value changes, or the worst case loss at a given level of confidence.

The model itself is best described in three parts:

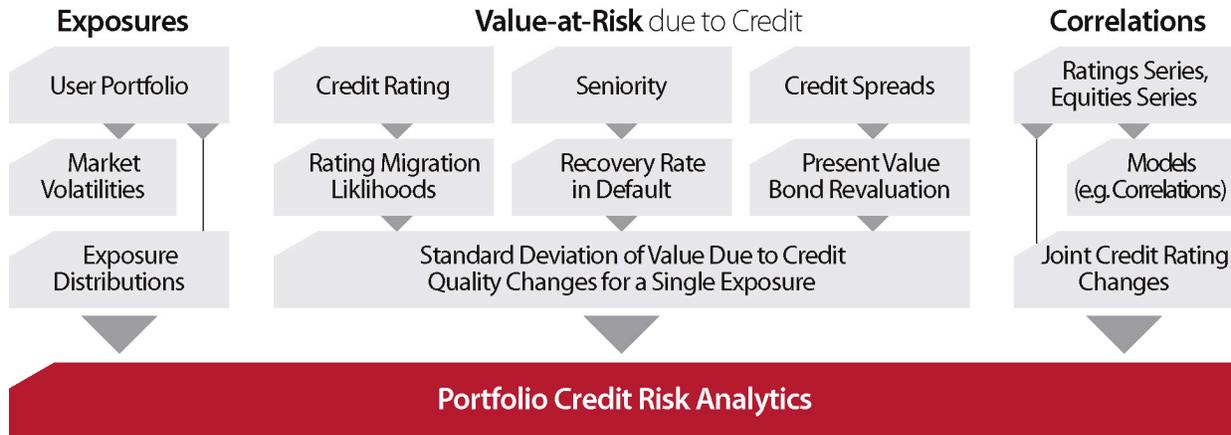
1. **The definition of the possible “states” for each obligor’s credit quality, and a description of how likely obligors are to be in any of these states at the horizon date.** A crucial element in this part is the creation of a ratings transition matrix providing the probability of rating changes.
2. **The revaluation of exposures in all possible credit states.** The model assumes a particular instrument’s value today is known, and must estimate its value, at a risk horizon, conditional on any of the possible credit migrations that the instrument’s issuer might undergo.
3. **The interaction and correlation between credit migrations of different obligors.** To describe a portfolio of exposures, CreditMetrics needs to construct correlations among them. To do this, we assume a “driver” of credit migrations: changes in asset value. (The CreditMetrics approach is conceptually similar to, and certainly inspired by, structural models such as Merton (1974), in which actual firm asset levels and volatilities are estimated, and linked to default probabilities.) In CreditMetrics, we do not seek to observe asset levels, nor to use asset information to predict defaults; the stand-alone information for each name (in particular the name's probability of default) is provided as a model input through the specification of the transition matrix. Assets are used only to build the interaction between obligors, but not to predict their individual behavior.

To begin the construction of correlations, we assume that asset value changes are normally distributed. We then partition the asset change distribution for each name according to the name's transition probabilities.

Once the partitions are defined for every obligor, the correlation among asset value changes are described. Rather than attempting to observe these changes directly, we make use of the equity correlation as an unbiased estimator for the asset value correlation.

With the correlations defined, the model is completely specified. In principle, it is possible to explicitly calculate the probabilities of all joint rating transitions (e.g. obligor 1 defaults, obligor 2 downgrades, obligor 3 stays the same rating, etc.). In practice, it is faster to obtain the portfolio distribution through a Monte Carlo approach. Thus, for a single scenario, we draw from a multivariate normal distribution to produce asset value changes, read from the partitions to identify these with new rating states and exposure values, and aggregate the individual exposures to arrive at a portfolio value for the scenario.

The fundamental methodology framework can be described in the diagram below.



The CreditMetrics methodology is described in detail in CreditMetrics Technical Document available from your RiskMetrics sales representative.

### III. Instrument Coverage

CreditManager supports positions in the following instruments, or asset types: Amortizing Bond, Amortizing Loan, Asset Backed Security, Bond, Cashflow Stream, Commitment, Credit Default Swap, Generic Asset Type, Guarantee, Letter of Credit, Loan, Loan Pool, Market Driven Instrument (like Forwards, Swaps or Options), Mortgage Pool, Securitization Exposure, Receivables.

### IV. Entering Holdings

Although CreditManager allows positions to be entered directly from the interface; positions are generally loaded in bulk from external files. These files are formatted in XML or CM3D, a tab delimited text-based format. Users can load positions directly from their own systems; or, a custom import mechanism can be configured, which will allow users to reload their positions from other databases directly. This will be the preferred mechanism for most clients. Upon logging into CreditManager users will have immediate access to their positions.

Note that all positions are stored in XML within the central positions database. Therefore no database schema changes are required when new types of asset classes are added to the analytics of CreditServer, greatly facilitating the addition of new valuation models.

## V. Stress Testing

CreditManager's stress testing reports allow users to comply with Basel II requirements. CreditManager's stress testing functionality allows clients to stress the following four factors:

- Recovery rate
- Correlations
- Transition matrices
- Spreads

Users can create and save new scenarios, as well as edit and save existing scenarios. They have the ability to access a library of saved and created scenarios and run stress testing reports comparing the statistics for two scenarios. Thus, in the most general terms, clients can perform scenario analysis. The Scenario Analysis Report shows the results (a set of statistics chosen by the clients) for the two scenarios and the delta or the difference in results between the two (either in relative or absolute terms).

## VI. What-if Analysis

CreditManager's What-if analysis can be used to investigate the impact of adding new asset(s) to an existing portfolio(s). It allows clients to investigate hedging opportunities and to examine the impact of potential trades. It produces reports on a portfolio risk-reward basis rather than on a purely stand-alone basis, which provides a more accurate measure of true cost.

## VII. Customized Reporting

The CreditManager risk-reporting framework, based on CreditMetrics™ methodology, utilizes a Monte Carlo engine to simulate credit events, allowing users to customize output across the various dimensions of their portfolio. Report templates include: Expected Returns, Limit Excession Report, Marginal/Incremental Risk, Risk vs Return Analysis, Credit Value at Risk (credit VaR), Risk Based Capital Allocation Top Ten Contributors to VaR (or any other Statistic) by Obligor. Credit Manager also provides visual representation of risk statistics with Scatter Plot, 3D Bar and Cone Charts, and Histograms.

Users can also plot any two risk statistics (e.g. expected returns, standard deviation, percentile losses) against one another and aggregate across any dimension of the portfolio (e.g. by industry, obligor, country)

- **Scatter Plot:** Plot of any two risk statistics against one another and aggregate the results across any dimension of the portfolio.
- **3D Table:** Bar or cone charts, which allow users to visualize risk concentrations across user-defined portfolio dimensions.
- **Histogram:** Credit value distribution at the end of the analysis horizon. Unlike symmetric bell-shaped market risk distributions, which can be characterized by a mean and standard deviation, the credit value distribution tends to be skewed and fat tailed due to the low likelihood but costly effects of default.
- **Reference Table:** Tabular representation of CreditManager's static and reference data. These lists include:
  - Countries
  - Currencies
  - Exposures
  - Industries
  - Obligors
  - Recovery Rate Tables
  - Stress Tests
  - Correlations

## VIII. Reporting Statistics

CreditManager reports provide the following statistics:

Economic Capital, Average Default Probability, Book Value, Cash Payments, Change Due to Default, Change Due to Rating Migration, Change Due to Roll Down, Current Value, Expected Change in Horizon Value, Expected Loss, Expected Return, Expected Shortfall, Exposure, Incremental Standard Deviation, VaR, VaR Contribution (Incremental VaR), Limit, Limit Excession, Limit Utilization, Mean Horizon Value, Regulatory Capital, Regulatory Exposure, Return on Economic Capital, Return on Regulatory Capital, Risk Weighted Assets, Standard Deviation

Statistics results can be viewed as actual value, as a percentage of exposure value or as a percentage of total portfolio value. All statistics can be attributed to any custom dimension such as sector, portfolio, currency, risk type, maturity, etc.

## IX. Batch Processing

Automated tasks can be set up to run at frequent intervals (for example at a fixed time each weekday, every day, or on certain days of the month), and cover most aspects of CreditManager functionality. If CreditManager is configured with access to an SMTP server (Mail server), e-mail notifications upon completion of the job can also be sent.

Current tasks which can be automated are:

- Delete all Obligors and Exposures
- Delete all Exposures
- Load Indices from server file
- Load FX rates from server file
- Load Yields from server file
- Load a Transition Matrix from server file
- Load spread curves from server file
- Load counterparties from server file
- Load exposures from server file
- Run Reports (multiple reports from the existing defined report list can be selected)
- Download market data from RiskMetrics
- Stop and restart all CreditManager services
- Save a system snapshot to server file

## X. Market Data

CreditManager provides all market data required for analysis, including:

- Yield curves
- Spread curves
- FX rates
- Transition matrices (Moody's and S&P 8 and 18-state), macro-economic factor based
- MSCI equity indices.

Leading providers in the data industry, including Dow Jones, Reuters, Standard & Poor's and Moody's, supply all CreditManager data. With the exception of the transition matrices, which are published on an annual basis, indices are updated weekly; yields, spreads, FX data are updated daily. CM users are notified of the updates via e-mail and can access the data directly through the CM application, through the RiskMetrics website ([www.riskmetrics.com](http://www.riskmetrics.com)), or through e-mail.

## XI. Obligors

A comprehensive database of obligors is available from RiskMetrics, as well as dynamic links to qualitative models such as CreditGrades and S&P's CreditModel.

## XII. Correlations and Weekly Time Series

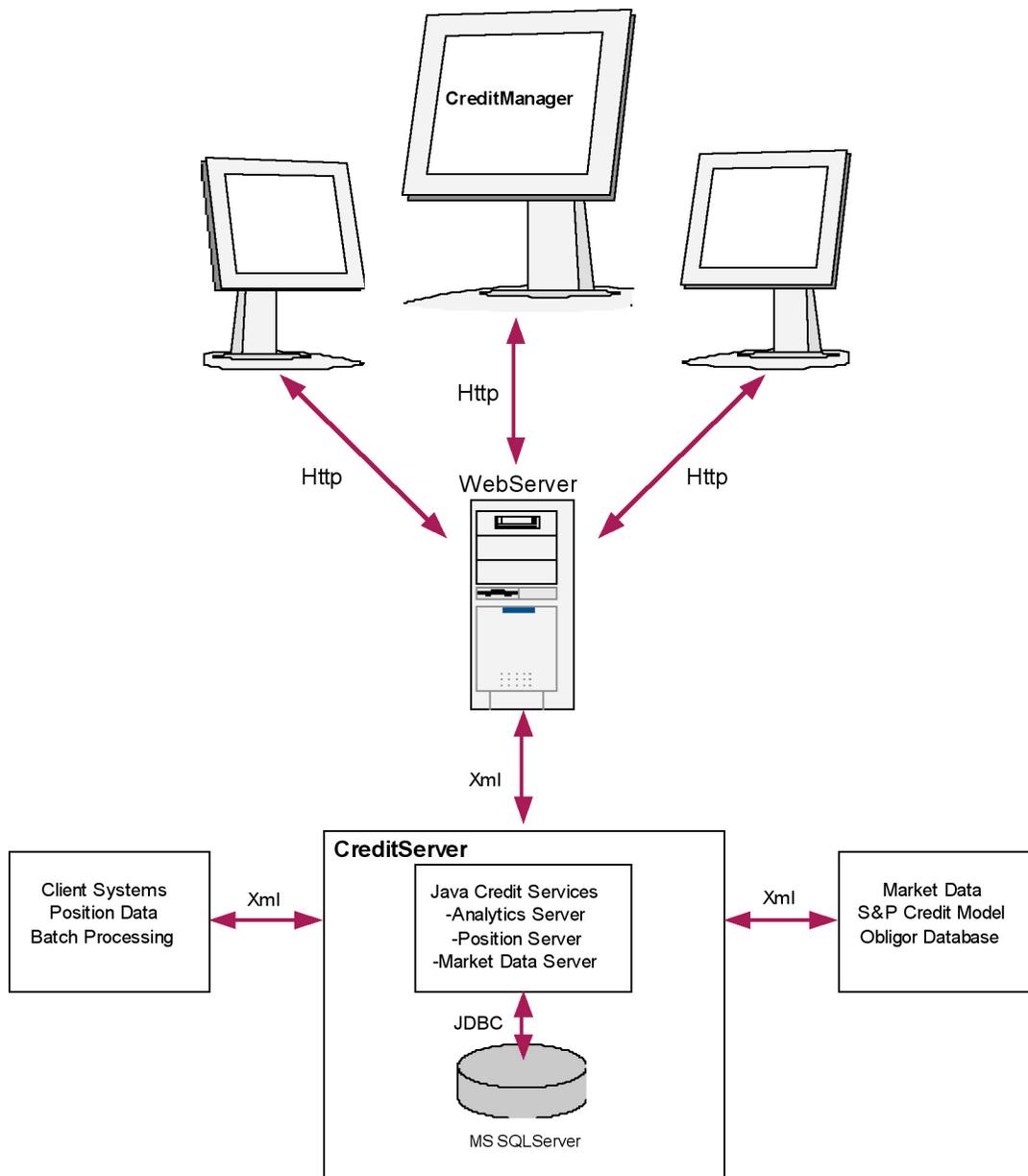
RiskMetrics provides CreditManager clients with weekly time series information to calculate asset correlations. The time series data covers the countries and industries listed in the MSCI equity indices. Alternatively, users may override the calculated correlations with a constant correlation across all industry pairs. Users may also include exposures, which do not map into countries belonging to the MSCI

equity indices, via proxy. CreditManager allows users to add new countries. Countries for which clients do not have time series can be mapped into existing index countries, for both determination of correlations and reporting. The time series information is updated on a weekly basis.

## Technical Overview

### CreditManager Technology Infrastructure

Credit Manager is a multi-tiered client-server application with a browser-based front end. The application is written in Java and utilizes a JSP (Java Server Pages) framework to serve web pages to end-users via their web browser. The backend analytics are written in Java and are available as a 64-bit application, allowing CreditManager to handle truly large analyses. The application is completely interactive and allows each user to explore portfolios, add positions, design reports, and run risk analyses. CreditManager is available as a locally installed application or as an ASP service. The illustration below depicts the System configuration for accessing CreditManager over the web as an ASP service.



The primary components of the system architecture are: The CreditManager Application, the CreditManager Database, and RiskMetrics Risk Services/CreditServer.

### CreditManager Application and Application Server

The CreditManager Application is written in Java 2 Enterprise Edition (commonly referred to as J2EE). J2EE applications are written in the Java programming language, and packaged to run on a J2EE-compliant Application Server. The Application Server runs the Java program code, presenting the application functionality to the user via an Internet Explorer Web Browser. This contrasts with a traditional “desktop” application, where program code is packaged to run on the PC’s operating system. The application functionality is presented to the user in dedicated graphical user interfaces which are generated by direct program calls to the Operating System’ API (Application Programming Interface). With a J2EE application, the program calls are made to the Application Servers’ API, resulting in dynamic web content being presented to the user’s web browser.

This application architecture allows users to access CreditManager from virtually any location, as long as they have access to the Internet through a web browser. Users of the CreditManager ASP are only required to have

Internet Explorer and a standard browser plug-in to access the full functionality of CreditManager over the Internet. No local installation or configuration is required.

## CreditManager Database

All user data, including positions, report definitions and stored report results are maintained in a separate database. The only access to this database is via the CreditManager application itself.

## RiskMetrics Credit Risk Services

The CreditManager application does not itself perform any risk analysis or risk calculations. Instead, when a user requests a report or group of reports to be run, CreditManager formats complete risk processing requests from those reports, and sends them to the “Credit Services” for processing. The Credit Services include multiple CreditServer risk analysis engines, which execute these queries and return the results to the CreditManager application for formatting and display. In this way the Credit Services provide risk analysis services to the CreditManager application.

Once connected to CreditManager users log in with their own user-names and passwords. They then have complete access to a full and dynamic risk system. CreditManager is *not* simply a distribution site for static, pre-processed reports. Rather it is a turnkey risk platform allowing users to:

- Run risk analyses on all their positions by computing risk statistics in any way desired over any drill-down dimensions specified.
- Dynamically change their positions by editing those that are already loaded, deleting others, and creating new ones. These may reflect actual trades or hypothetical deals. In the latter case this enables users to re-compute risk and determine the impact of a trade before it is placed.
- View their analyses in an interactive fashion from dynamic drilldown reports.
- Edit positions from those reports and rerun an analysis.
- Create new types of reports from existing report templates and run those reports immediately.
- Share reports and positions with appropriately permissioned users.

## CreditManager ASP Technical Overview

The CreditManager application provides fully interactive, web based access to RiskMetrics’ risk analytics and benchmark risk methodologies. The CreditManager ASP delivers this market-leading functionality directly to users via the Internet. Users can interact directly with the CreditManager ASP GUI using Internet Explorer from their desktops.

### Main Features

The CreditManager ASP is a hosted service provided by RiskMetrics. The CreditManager application and the hardware on which it runs are located remotely from the client site. Users access the full interactive functionality of the CreditManager risk management application over the Internet using a web browser. Using this web interface, users can create and edit positions, define complex reports and stress tests, and report market data and risk statistics based on that market data.

The CreditManager ASP provides an attractive solution to the problems of procuring and implementing complex risk management systems, and provides cost effective solutions to the demands of system ownership. The overall benefits can be summarised as follows:

1. Allows rapid and wide adoption of risk management practices across an organization.
2. Provides scalability as risk management needs grow.
3. Lower total cost of ownership, and reduced upfront cost of ownership.
4. Provides smoother cost structure and better ability to forecast costs.

5. Firms pay for quality of service.
6. Implementation times down from years to months & weeks.
7. Eliminates the constant system update cycle.
8. Frees up scarce IT and operations staff.
9. Transfer of software asset ownership risk & technology risk.
10. Rapid access to technologies otherwise unavailable due to cost/resource constraints.

The main features of the CreditManager ASP are:

- It is a full functionality, multi-user Risk Management application
- It is scalable for deployment ranging from individual desktops to departmental and enterprise use, including integration with client systems and automation of risk analysis and reporting.
- It has a low cost of deployment and supports rapid implementation. The only client-side requirements are for desktop Internet access using the HTTPS protocol, and for Internet Explorer.
- Only licensed, paying clients of RiskMetrics use the CreditManager ASP. Evaluation and Test users have access to a totally separate Evaluation ASP service.
- The CreditManager ASP includes a full security model, which restricts and controls access to the application and all client data loaded into the system.

### Analytics Processing

The hardware used to run analyses on the ASP site differs significantly from that which may be available to a local install client. CreditServer used 32 bit and powerful 4-processor and 8-processor, dual-core 64 bit Opteron servers. Furthermore, CreditServer's 64 bit architecture allow for processing reports with over 100,000 exposures.

### Service Level Agreement

RiskMetrics believes that the CreditManager ASP is first and foremost a service to clients. The provision of this service is governed by the standard Service Level Agreement (SLA), which includes provisions for:

- System Availability
- Maintenance Procedures
- System Performance
- System Management
- Change Management Procedures
- Release Management Procedures
- Security Procedures
- Client Support
- Problem Management
- Backup Procedures
- Disaster Recovery Procedures

For more information on CreditManager from RiskMetrics Group, please email [marketing@riskmetrics.com](mailto:marketing@riskmetrics.com) or visit [www.riskmetrics.com](http://www.riskmetrics.com).

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