Compliance with 2003 Standards

Presentation to

Florida Commission on Hurricane Loss Projection Methodology

May 12, 2004

Presentation Overview

Follows sequence of ’03 Report of Activities

- General
- Meteorological
- Vulnerability
- Actuarial
- Statistical
- Computer

Standard G-1: Scope of the Computer Model and its Implementation

- Model version number: RiskLink 4.32a
  - Updated from RiskLink 4.3a in ‘02 submission
- Concise description of the model provided in the ‘03 submission document
  - No material changes
  - Minor revision to reduce redundancy
- Flow diagram (Fig. 4, pg 24) illustrating interactions among major model components
  - No material changes in component interactions
  - Minor revision to improve clarity of descriptions
- Other aspects of this standard remain unchanged from 2002

Standard G-2: Qualifications of Modeler Personnel and Independent Experts

- Employee/revenue/client statistics and biographies updated
- Professional credentials updated to include software development team, reflect changes in employment status, and specify tenure
  - No employees removed from the project for unprofessional conduct
- Dr. Nicholas Cook's assessment report was added in Appendix A
- Other aspects of this standard remain unchanged from 2002

Standard G-3: Risk Location

- USPS vintage of the ZIP Code data updated to August 2003
- Other aspects of this standard remain unchanged from 2002

Standard G-4: Units of Measurement

- Sources of conversion factors added to disclosures
  - Conversion factors related to units are consistent with 2002 IEEE/ASTM standards
    - Reference: American National Standard for Use of the International System of Units (SI): The Modern Metric System", IEEE/ASTM SI 10
  - Meteorological and wind engineering conversion factors are taken from standard meteorological and wind engineering sources
    - Reference: WMO, Global Guide to Tropical Cyclone Forecasting, 1993; Cook, 1985
- Other aspects of this standard remain unchanged from 2002

Standard G-5: Independence of Model Components

- RMS' response to this standard remains unchanged from 2002
- The vulnerability, meteorological, and actuarial model components are theoretically sound and have each thoroughly and independently tested and calibrated
- They have also been tested in an integrated way to ensure that the relationships between the components are reasonable

Standard M-1: Official Hurricane Set

- RMS' response to this standard remains unchanged from 2002
- The hurricane set used by RMS for Florida matches the Official Storm Set and includes all storms listed in the Report of Activities through 2002

Standard M-2: Hurricane Characteristics

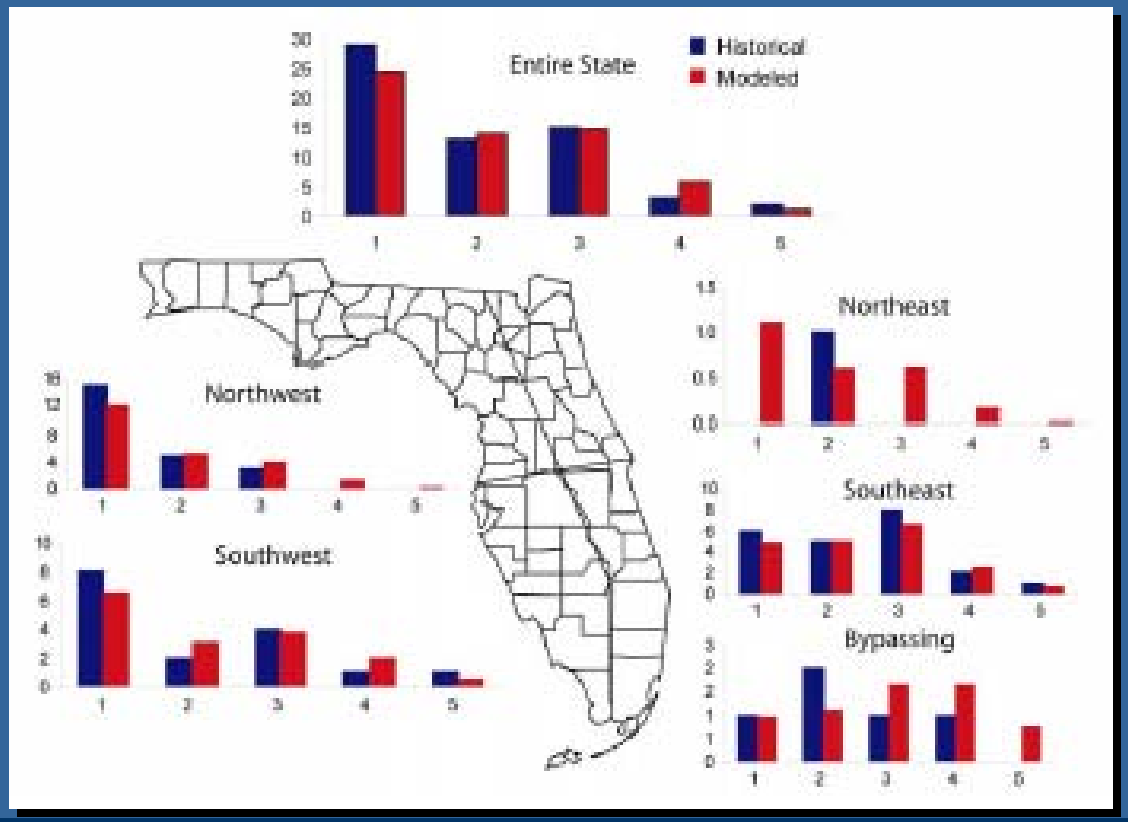
- Asymmetric nature of modeled hurricanes (disclosure M-2.4)
  - Description of variation in gradient-to-surface wind speed coefficients by side of track added
- Comparison of historic and modeled multiple landfall occurrences by pair of adjacent 50 km gates was included (Figure 6) to support disclosure M-2.6
- Description of probability distributions for hurricane characteristics modeled as random variables expanded
- Other aspects of this standard remain unchanged from 2002
- Methods for depicting all modeled hurricane characteristics are based on currently accepted scientific literature or modeler information previously accepted by the Commission

Standard M-3: Landfall Intensity

- Categorization of landfall intensity and definition of an event in the model remains unchanged from 2002, and was verified by the Professional Team
- The maximum wind speeds produced by the model per hurricane category are consistent with the Saffir-Simpson Scale

Standard M-4: Hurricane Probabilities

- Complete list of the source documents used to develop the model's variable functions/databases disclosed
- Distributions of hurricane frequency by category and region have been updated to reflect the renormalization of stochastic event rates
- Other aspects of this standard remain unchanged from 2002



Standard M-5: Land Friction and Weakening (1)

- Source information on the land use and land cover data used in the model was described in more detail and reviewed by the Professional Team
- Other aspects of the land friction portion of this standard remain unchanged from 2002
- The treatment of roughness in the RMS U.S. Hurricane model is based on Cook/ESDU methodologies
- Wind speeds at a location are impacted by the local and upstream surface roughness in eight different directions
- Approach used has been reviewed by Cook, who concluded

  "RMS have correctly implemented well-established scientific principles and practices to produce a high quality model for the wind speed field in U.S. Hurricanes."

Standard M-5: Land Friction and Weakening (2)

- Inland penetration of hurricane force winds added (Table 10) to support disclosure M-5.1
- Other aspects of the overland weakening rate in this standard remain unchanged from 2002
- The wind speed decay for each storm follows the functional form of the Kaplan and DeMaria (1995) model
  - Based on a cleaned data set
  - Widely accepted peer-reviewed reference
- The RMS model allows variation in the filling rate but in the mean is consistent with Kaplan & DeMaria

Standard M-6: Logical Relationships of Hurricane Characteristics

- Form M-1 (Table 11) and Form M-3 (Figures 11 & 12) have been updated to reflect renormalization of stochastic event rates

- Other aspects of this standard remain unchanged from 2002

Standard V-1: Derivation of Vulnerability Functions

- No changes to vulnerability functions
- Flow chart was added to this year's submission to document the process by which vulnerability functions are derived and implemented (Figure 13)
- Site inspections and resulting use of data added for disclosure V-1.3
- Form V-1 submitted
- Other aspects of this standard remain unchanged from 2002

Standard V-1: Derivation of Vulnerability Functions

- A - Vulnerability functions are based on well-supported structural and wind engineering principles and detailed analyses of historical claims data
- B – Methods used to derive vulnerability functions are theoretically sound
- C – Secondary Modifiers to Vulnerability functions based on engineering understanding, damage statistics, building codes, engineering studies, wind tunnel experiments

Standard V-1: Derivation of Vulnerability Functions

- D – Construction types and Primary Characteristics

Construction Class
Unknown
Wood Frame
Masonry
Reinforced Concrete
Steel Frame
Light Metal Frame
Mobile Home without Tie-Downs
Mobile Home with Tie-Downs

of Stories
Unknown
1
2-3
4-7
8-14
15+

Occupancy
Unknown
Single Family
Multiple Family
Non-Residential

Standard V-1: Derivation of Vulnerability Functions

- E – Changes in building codes/construction practices are modelled through “Year Modifiers”

- F – Separate vulnerability functions
  - Derived for structures and mobile homes,
  - Appurtenant structures use same function as main structure, but can be input separately
  - Separate functions for contents, ALE

- G – Minimum wind speed generates damage
  - 50 mph peak gust
  - ~42 mph one minute sustained

Standard V-2: Mitigation Measures

- The following secondary modifiers are available in the model:
  - Roof sheathing strength
  - Roof covering
  - Roof anchor
  - Foundation system
  - Wind resistance of window openings
  - Wind resistance of door openings
  - Roof geometry
  - Opening protection (shutters)

- The application of modifier options are reasonable when applied individually and in combination

Standard A-1: Underwriting Assumptions

- RMS' response to this standard remains unchanged from 2002
- RMS uses historical loss information in the development of vulnerability functions
  - Any adjustments, edits, inclusions, or deletions to insurance company input are based on accepted actuarial, underwriting, and statistical procedures and are documented in writing
  - The vulnerability of property observed in historical events is assumed to be indicative of vulnerability of such property in future events where subjected to similar wind loads

Standard A-2: Loss Cost Projections

- RMS' response to this standard remains unchanged from 2002
- RMS loss cost calculations do not include expense, risk loads, investment income, premium reserves, or profit margins
- RMS loss cost projections do not make any prospective provision for economic inflation.
- The RMS model does not include demand surge in its loss cost projections

Standard A-3: User Inputs

- Location level user input forms (Appendix D, pg 315) were added
- Other aspects of this standard remain unchanged from 2002

Standard A-4: Logical Relationship to Risk

- RMS' response to this standard remains unchanged from 2002

- Loss costs do not display an illogical relation to risk, nor do they vary significantly when the underlying risk does not change significantly
- Loss costs are positive and non-zero for all Florida ZIP Codes
- Loss costs do not increase as roughness increases
- As illustrated in the output ranges, loss costs:
  - do not increase as quality increases, all other factors held constant
  - decrease as deductibles increase
  - exhibit relationships between coverages and loss costs for each coverage that are consistent and reasonable

Standard A-5: Deductibles and Policy Limits

- RMS' response to this standard remains unchanged from 2002

Loss net of deductible and limit = $\int_{D}^{D+L} (x - D) f(x) dx + L[1 - F(D + L)]$

where x = ground-up loss
D = deductible
L = limit
$f(x)$ = p.d.f. of the ground-up loss
$F(x)$ = c.d.f. of the ground-up loss

Standard A-6: Contents

- RMS' response to this standard remains unchanged from 2002

- Contents and building loss relativities are based on an analysis of historical claims data
- The relationship between buildings and contents losses are reasonable

Standard A-7: Additional Living Expenses (ALE)

- RMS' response to this standard remains unchanged from 2002

- ALE losses include only hurricane related factors, are theoretically sound, and consider the time to repair the structure
- ALE losses are determined based upon the estimated damage to the structure
- ALE and building loss relativities are based on an analysis of historical claims data and is reasonable

Standard S-1: Use of Historical Data

- The form of the probability distributions used for each function/variable was added. Statistical techniques used for the estimates and the specific goodness of fit tests applied were added to comply with disclosure S-1.1
- The portion of the observed wind speeds within various levels of the observed wind speeds were added (Table 18) to support disclosure S-1.3
- Confidence intervals for Central Pressure, Forward Speed, and RMax cumulative distribution functions were added to RMS' submission to comply with disclosure S-1.5

- Other aspects of this standard remain unchanged from 2002

- RMS uses empirical methods in model development and implementation to match stochastic storm generation to historic data, which is supported by currently accepted scientific literature. The resultant distributions have been shown to have reasonable agreement with the historic data.

Standard S-2: Sensitivity Analysis for Model Output

- Added a description of the approach to vary the standard deviation of RMax by the central pressure and latitude of storm at landfall (taken prior to the 2002 submission) based on the sensitivity of the output results
- Other aspects of this standard remain unchanged from 2002
- Sensitivity analyses follow the procedures described in the paper:

  "Assessing Hurricane Effects. Part I. Sensitivity Analysis," by Ronald L. Iman, Mark E. Johnson, and Tom E. Schroeder

Standard S-3: Uncertainty Analysis for Model Output

- Added a description of the approach to vary the standard deviation of RMax by the central pressure and latitude of storm at landfall (taken prior to the 2002 submission) based on the uncertainty of the output results
- Other aspects of this standard remain unchanged from 2002
- Uncertainty analyses follow the procedures described in the paper:

  "Assessing Hurricane Effects. Part 2. Uncertainty Analysis," by Ronald L. Iman, Mark E. Johnson, and Tom E. Schroeder

Standard S-4: County Level Aggregation

- Description of the importance sampling design was provided to comply with disclosure S-4.1. This procedure includes

  1. Random selection
  2. Optimization of storms to reactivate
  3. Multiple landfall rate renormalization
  4. Cycling between steps 2 and 3 to reduce the scatter from the targets (average annual loss and rates)

- Other aspects of this standard remain unchanged from 2002

Standard S-5: Replication of Known Hurricane Losses

- Standardized residual plots for wood/masonry and separately for mobile homes were provided and reviewed during the Professional Team audit.

- Other aspects of this standard remain unchanged from 2002

Standard S-6: Comparison of Estimated Hurricane Loss Costs

- The 95% confidence interval on the differences between the mean of the historical and the modeled losses was provided in support of disclosures S-6.3 and S-6.4 (reviewed by Professional Team in 2002)
- Other aspects of this standard remain unchanged from 2002
- The difference between the annual average zero-deductible, statewide loss costs for the historical event set and using the RMS modeled event set is statistically reasonable

Standard S-7: Output Ranges

- Differences in the updated output ranges from RMS' 2002 submission are reasonable and driven by two factors
  - Update of hurricane rates to account for the passage of a year
  - Upgrade of ZIP Code USPS vintage to August 2003

- Differences between this year's and last year's weighted average loss costs for all counties are less than 10%

Standard C-1: Documentation

- Computer Standards document binder
  - Contains sample material addressing each standard
  - Cross-references material to each standard via "Index to Documents"
  - Was reviewed by the Professional Team
- Binder updated and expanded for RiskLink 4.32a to:
  - Reflect model updates
  - Reflect improvements in development processes and procedures
  - Address new standard, C-7: Security

Standard C-2: Requirements

- RMS' response to this standard remains essentially unchanged from 2002

- Documents and requirement types covered:
  - RiskLink System Administration (resource, security, database interface)
  - Visual SourceSafe Introduction & Overview (security)
  - Coding Standards (user interface, human factors design, source code design, implementation, database design and coding, component interface design)
  - Documentation templates (user interface, functionality, data, resources, quality assurance)
  - Project management documents (resources)
  - RiskLink DLM User Guide (user interface, functionality)

Standard C-3: Model Architecture and Component Design

- RMS' response to this standard remains essentially unchanged from 2002

- Control flow diagrams
  - Illustrate key processes, branches, and loops within software
- Data flow diagrams
  - Illustrate data-dependency relationships between software components
- Component diagrams
  - Document software module interfaces
- Database schema documentation
  - Describes client-accessible databases
  - Describes internal databases
- Model component custodian documentation
  - Lists software developers for each major component
  - Shows association between each component and actual source code

Standard C-4: Implementation

- RMS' response to this standard remains essentially unchanged from 2002

- Data flow diagrams
  - Demonstrate hierarchical decomposition of processes
  - Processes range from very high level down to processes implemented within individual methods in source code

- Data dictionary
  - Links processes on data flow diagrams to source code

Standard C-5: Verification (1)

- RMS' description of procedures for verification and tests performed for each software component were expanded to reflect the **expansion of quality assurance since 2002**

- Summary of procedures for verification
  - **Design and prototype** of model modifications/additions
  - **Written specifications** describe purpose, algorithm (e.g., pseudo-code, control flowcharts, or data flow diagrams), and testing plans
  - **Review of specifications** by both engineers and by senior software developers
  - **Independent execution of test plans** by RMS engineering and Quality Assurance
  - **Code inspections**, reviews, and walk-throughs to verify code correctness
  - **Catch run time errors** by embedding numerous logical assertions, exception handling mechanisms, and flag-triggered output statements in source code

Standard C-5: Verification (2)

- RMS' description of procedures for verification and tests performed for each software component were expanded to reflect the **expansion of quality assurance since 2002**

- Summary of tests performed to ensure correct response to inputs
  - **Test plans** developed and reviewed
  - Special purpose **test driver programs** written to verity the stability of the component outputs
  - **Suites of test scripts** run to:
    - **Check output** from logical assertions, exception handling mechanisms, and flag-triggered output statements
    - **Perform "regression tests"** (comparing output to expected results)
  - Use of **Rational/IBM Test Studio** package to centralize test plan documentation and to automate test script execution and verification
  - Extensive use of **software debuggers** to verify execution paths and calculation results

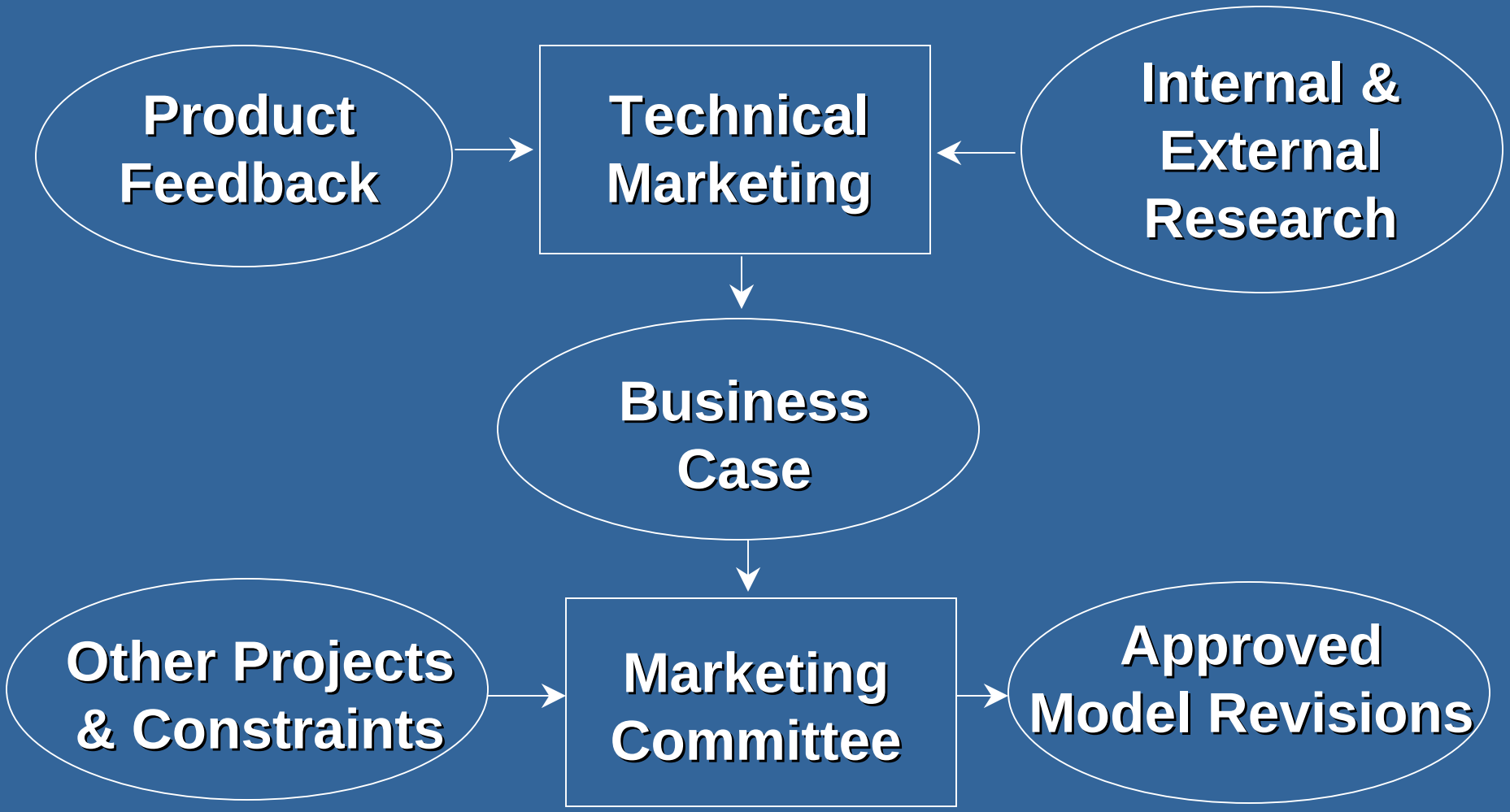
Standard C-6: Model Maintenance and Revision

- RMS' response to this standard remains essentially unchanged from 2002, but more detail now included in submission

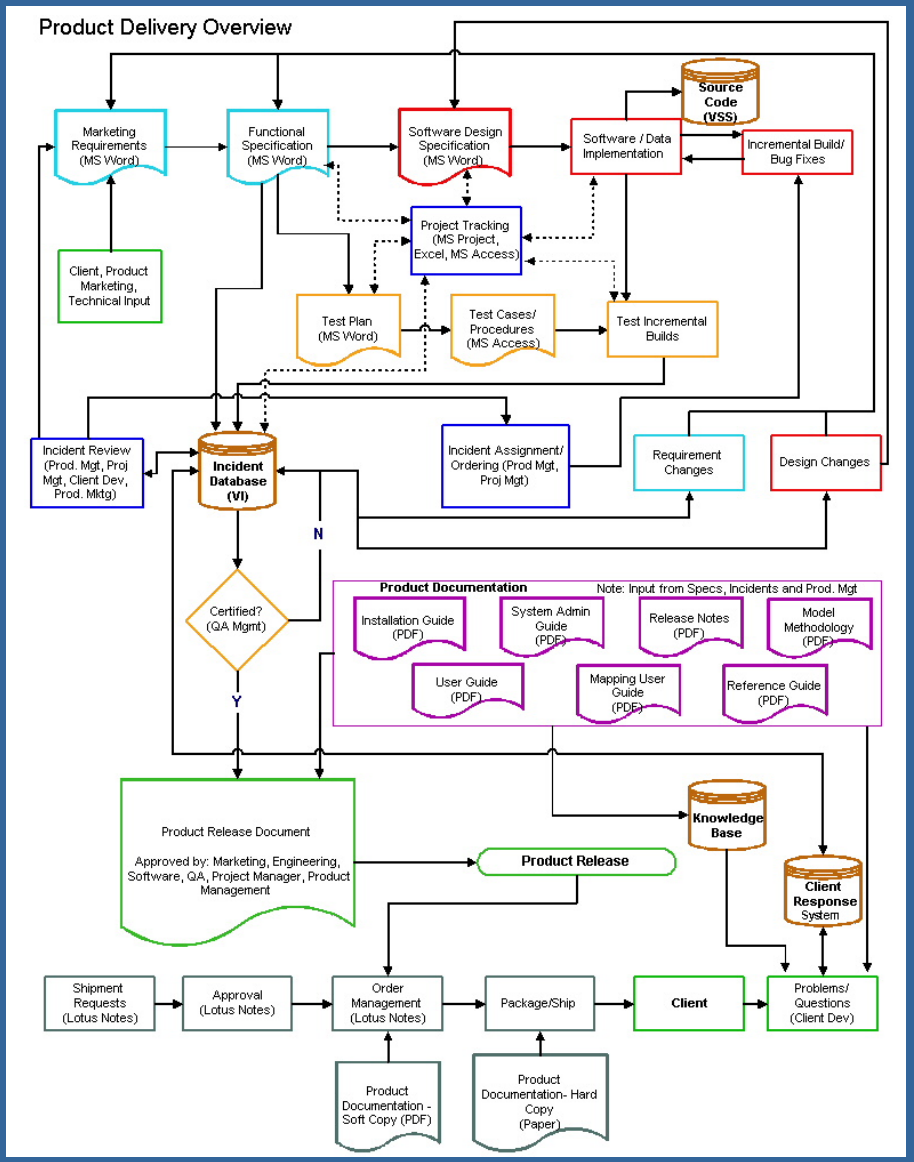
- Visual Intercept Quick Reference Guide
  - Describes use of tool for tracking features and fixes
- Sample Visual Intercept incidents
  - Demonstrate use of VI for tracking feature development
- Client Response System
  - CRS knowledge base article demonstrates support documentation
  - CRS ticket demonstrates tracking of interaction with client
- File Versioning
  - Documents how software versioning is done
- Most Recent Change By Component
  - Lists dates of code change by software component

- Product Delivery Overview (new)
  - Illustrates maintenance / revision process in detail

Standard C-6: High-level Model Revision Policy



Standard C-6: Detailed Model Revision Policy



Standard C-7: Security

- RMS has implemented security procedures for access to code, data, and documentation in accordance with standard industry practices
  - Security requirements **documented and enforced** by RMS Legal Department
  - Company **personnel are trained** in security requirements and procedures
  - Company personnel required to sign **non-disclosure agreement** as condition of their employment
  - **Physical security** maintained using locked doors, key-card access, video cameras, and security patrols
  - RMS network protected via hardware **firewalls**
  - Servers and desktops protected with Norton **Antivirus software**
  - Servers and desktops **audited for security compliance**
  - Microsoft **Visual Source Safe used to track modifications** of source code. VSS maintains source code in **encrypted** form. A **separate login** required to access source code. **Nature and author of all changes recorded**.
  - **Servers backed up** nightly. **Off-site backups** are maintained at a secure commercial facility