Accelerating the Construction of a Requirements Traceability Matrix in Telelogic DOORS® using the LDRA Tool Suite™

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Agenda

• Introduction to LDRA
  – Partnership with Telelogic

• Project Challenges
  – Requirements
  – Verification
  – Traceability

• Requirements-Driven Development
  – Automating Verification
  – Automating RTM Construction
Introducing LDRA

Liverpool Data Research Associates

Founded 1975

Provider of Test Tools & Solutions

Metrics Pioneer

Consultancy, Support & Training
LDRA Solution Capabilities

LDRA tool suite

- Test Manager
- Requirements Workflow
- Design Review
- Code Review
- Unit Testing
- Quality Review
- Target Testing
- Test Verification

- Requirement Based Development and Verification Solution
- Programming Standards Checking
- Code Complexity & Density
- Source & Object Code Verification
- Total unit test automation - Driver, stubs, global data & test vectors
- Embedded target testing support
Telelogic & LDRA In Partnership

• Partners since 2003
• Combined workshops since 2006
• Rhapsody Integration
• DOORS Integration
Requirements and Analysis Challenges

- Overwhelming complexity
- Ambiguous and imprecise communication
- No common understanding of requirements
- Scope creep & requirements churn
- Maintaining stakeholder commitment & agreement
- Compliance with software and industry standards
- Delivered solution fails to meet true stakeholder needs
Verification Challenges

- Imprecise, incomplete and unstable requirements
- Brittle architecture (fails under stress)
- Uncontrolled change propagation
- Undetected inconsistencies in requirements, design and implementation
  - Disjointed software development
  - Traceability matrixes, usually a low-priority task, carried out manually, continual human interaction and interpretation
- Insufficient time for testing
  - Final phase in the process, inevitably squeezed as earlier phases overrun
“Requirements traceability refers to the ability to describe and follow the life of a requirement, in both forwards and backwards direction (i.e. from its origins, through its development and specification, to its subsequent deployment and use, and through all periods of on-going refinement and iteration in any of these phases.)”

Gotel & Finklestein

“Requirements traceability refers to the ability to define, capture and follow the traces left by requirements on other elements of the software development environment and the trace left by those elements on requirements.”

Pinheiro & Goguen

“In the requirements engineering field, traceability is about understanding how high-level requirements – objectives, goals, aims, aspirations, expectations, needs – are transformed into low-level requirements. It is therefore primarily concerned with the relationships between layers of information.”

Hull, Jackson & Dick
CMMI SP 1.4 Maintain Bidirectional Traceability of Requirements

“The intent of this specific practice is to maintain the bidirectional traceability of requirements for each level of product decomposition. When the requirements are managed well, traceability can be established from the source requirement to its lower level requirements and from the lower level requirements back to their source. Such bidirectional traceability helps determine that all source requirements have been completely addressed and that all lower level requirements can be traced to a valid source. Requirements traceability can also cover the relationships to other entities such as intermediate and final work products, changes in design documentation, and test plans.”

DO-178B 5.1.2 Software Requirements Process Activities

h. Each system requirement allocated to software should be traceable to one or more software high-level requirements.

i. Each high-level requirement should be traceable to one or more system requirements.

DO-178B 5.2.2 Software Design Process Activities

a. Low-level requirements and software architecture developed during the software design process should conform to the Software Design and be traceable, verifiable and consistent.
• A Requirements Traceability Matrix (RTM) can be a key deliverable

• Silo-like development phases → tenuous links and references between themselves and the overall RTM
  – Requirements: centralised, database-like RM tools

• Each development phase flows into the next, traceability is assumed but not recorded
  – Low profile, little support from tooling, RTM is poorly maintained, rush job to complete

• Requirements manager is a database specialist with responsibility for the RTM on multiple projects
  – Light-weight repository (e.g. Excel) with no direct connectivity to the software development artefacts
Traceability Across Development Tiers

Tier 1: High-Level Requirements

Requirements Traceability Matrix

Tier 2: Modelling Tool
Legacy Code/Architecture
Software Specs Hand Code

Requirements Traceability Matrix

Tier 3: Implementation (Source Code / Assembly)

Requirements Traceability Matrix

Tier 4: Host Tier (Node 1 – n)

Requirements Traceability Matrix

Tier 5: Target Tier (Node 1 – n)

LL Reqs to HL Reqs

Design Review defects

Code to LL Reqs

Code & Quality Review defects

Test Results & Defects

Test Cases to LL Reqs
LDRA and Requirements Traceability

Requirements Capture & Traceability

Requirements Allocation & Mapping

Requirements Verification

LDRA TReq® Requirements Traceability

LDRA Testbed® Programming standards and quality metrics

LDRA TBrun® Automated Unit Testing

Test Verification

DOORS®

LDRA Verification Workflow Engine
### Requirements for Groceries

<table>
<thead>
<tr>
<th>ID</th>
<th>Requirements for Groceries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maintain Account</td>
</tr>
<tr>
<td></td>
<td>The system shall enable a customer to create and add cash to an account.</td>
</tr>
<tr>
<td>2</td>
<td>List Prices</td>
</tr>
<tr>
<td></td>
<td>The system shall enable a customer to view a price list of the currently available produce.</td>
</tr>
<tr>
<td>3</td>
<td>Specify Favourite</td>
</tr>
<tr>
<td></td>
<td>The system shall enable a customer to specify which of the available produce is their favourite.</td>
</tr>
<tr>
<td>4</td>
<td>Determine Lowest Price</td>
</tr>
<tr>
<td></td>
<td>The system shall enable a customer to determine which available produce has the lowest price.</td>
</tr>
<tr>
<td>5</td>
<td>Determine Health Benefit</td>
</tr>
<tr>
<td></td>
<td>The system shall enable a customer to determine which available produce provides the maximum health benefit.</td>
</tr>
<tr>
<td>6</td>
<td>Price Modification</td>
</tr>
<tr>
<td></td>
<td>The system shall enable a system administrator to modify the prices of available produce.</td>
</tr>
<tr>
<td>7</td>
<td>User Output Confirmation</td>
</tr>
<tr>
<td></td>
<td>The system shall update the user display within 500 ms of a state change.</td>
</tr>
</tbody>
</table>
Create Test Structure

Covering relations
Workflow Management

Role and user-based workflow management
Automating Trace Relationships

- Link source code to requirements
- Create links right down to procedure level
Requirements-Driven Verification
Requirements-Driven Verification
Trace relationships created automatically as a consequence of verification work.
Step-by-Step RTM Construction

Percentage coverage to date
Export to DOORS

Exported Modules automatically created in DOORS
In Summary

- Everything begins with high quality requirements
  - Telelogic DOORS
  - Quality (good or bad) will ripple down the project lifecycle
- Tools must support cross-cutting disciplines
  - Version control, change management, requirements traceability
- Requirements traceability is arguably the last major project discipline to be automated
- LDRA’s workflow management ensures trace links are recorded as soon as they are made
  - Step-by-step is so much easier than ‘big bang’
- Continuously update the RTM
  - Automate... Accelerate... Optimise
Thank you for your interest

For more information please contact

www.ldra.com

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