Recovering Business Rules from Legacy Source Code for System Modernization

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Introduction

- **Legacy software**

```
000009* PROGRAM TITLE:
000010* DATE CREATED:  JULY 1979
000011* AUTHOR:        UNKNOWN
000012* DESCRIPTION:
```

- **Common**
  - In 2006, 70% of all transaction systems were written in COBOL

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Introduction (2)

- **Modernization**
  - Motivations
    - High cost to operate legacy system
    - Impossible to keep the legacy system up-to-date
    - Lack of qualified staff
  - New system or integrate legacy with new system
    - Need for requirements
  - Many requirements buried in the source code
  - Recovering business rules major issue
    - Recent survey from Software AG: 51% of companies who have difficulties modernizing said that a major issue are “hard-coded and closed business rules”
- **Objective**
  - How to recover business rules from legacy source code?

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Outline

- **Context**
- **Extraction process**
- **Visualization and navigation**
- **Conclusions**

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Legacy Systems

- They handle and process a large amount of data.
- They have a large user base.
- They involve many business rules linked to legislation, agreements, processes, etc.
- Many business rules are not accurate anymore and require external error and exception processing because of the difficulty to improve and update such system.
- The maintenance of the system often involves changes related to business rules.
- The source code is available – most developments “in-house”.

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Stakeholders

- Two main classes of the stakeholders are involved with business rules:
  - *Legacy system maintainers*
    - Fix bugs and implement new rules.
    - Need to understand the business rules they are affecting and the execution paths to a specific business rule
  - *Business analysts*
    - Involved in modernization of the legacy system
    - Business rules in legacy system used for validating new requirements or finding requirements
    - Often no background in technologies used in legacy system

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Objectives

- **Build an extensible and customizable framework for knowledge extraction**
- **Extract business rules in the following form:**
  - If <conditions> then <consequence>
  - <conditions> and <consequence> as easy to understand as possible
- **Use "business terms" instead of programming language constructs**
- **Focus on calculations**
  - Representation of complex calculations in an "easy" format
- **Provide navigation and visualization to locate information**
- **Focus on COBOL legacy software**

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COBOL

- **Limited and simple structure**
  - each program = sequence of statements grouped into paragraphs which are executed sequentially
- **Only two forms of branching**
  - one to execute external programs (CALL)
  - another to transfer the control flow to a paragraph (PERFORM). PERFORM is also used for iterations.
- **Each program is associated with a single source file.**
- **Elements of Business Rules**
  - Branching: execute a paragraph
  - Calculations: compute calculations between variables into another
  - Conditions

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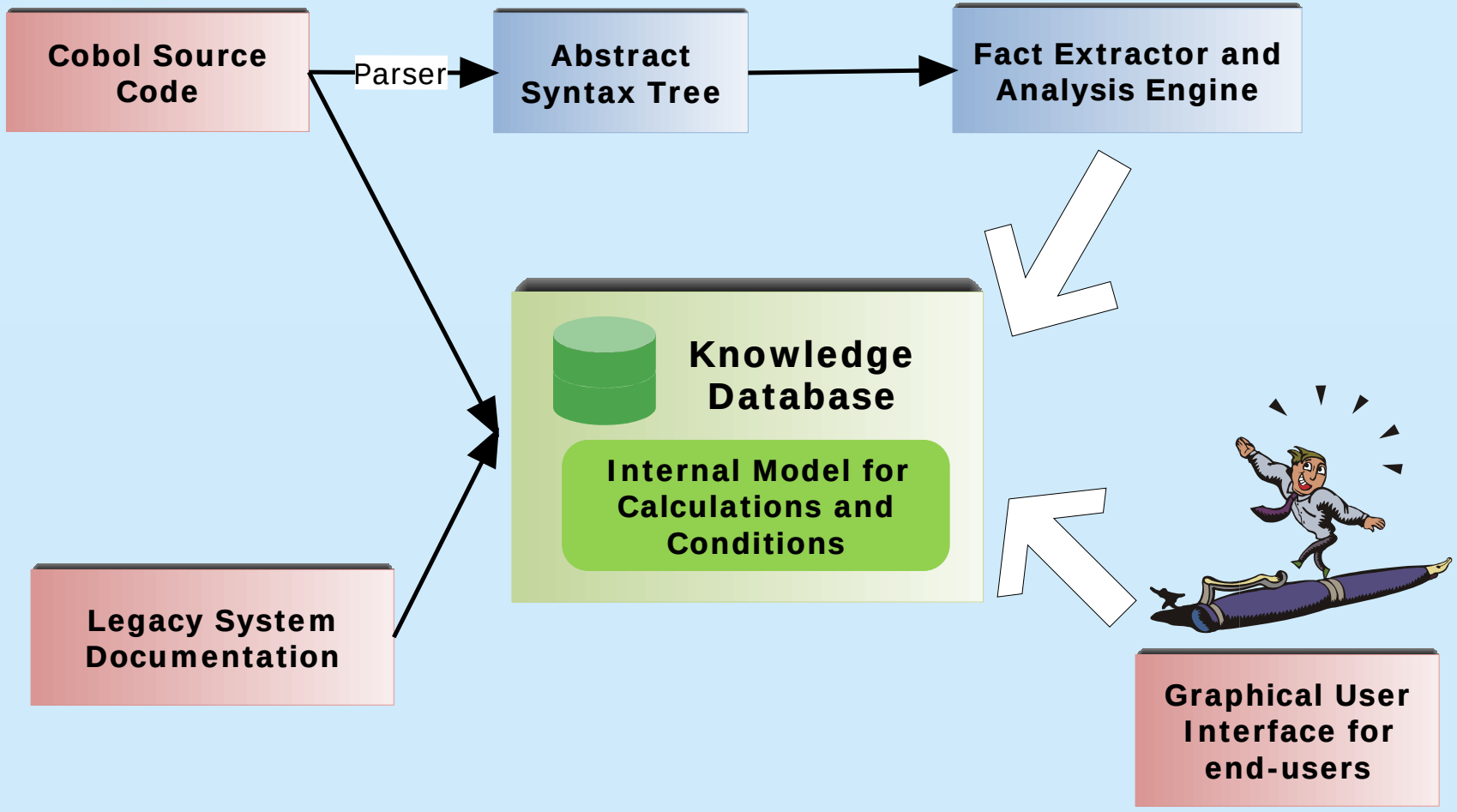
Platform overview



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Knowledge database

- **Main elements**
  - Business rules = condition + action
  - Action: calculation or control flow branching
  - Conditions: Boolean operations between identifiers
  - Calculations: arithmetic operations between identifiers
  - Identifiers
- **Keyword indexing all of elements**
- **Source code**
  - All extracted artifacts are linked to source code
- **Variable names translation to business terms**

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From Source code to Business Rules

- **Abstract Syntax Tree**
  - Extract machine level representation of the source code
- **Business Rules construction**
  - Locate calculations
  - Locate conditions
    - Combine nested ifs
  - Simplify calculations
  - Simplify conditions
  - Compute dependencies between business rules
- **Integrating documentation and comments**
  - Attach comments to relevant elements

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Implementation

- **Technologies**
  - Object oriented database DB4O for storing and querying business rules
  - Antlr3 (LL-*) parsing for generating AST from COBOL
- **One major legacy system**
  - 630000 lines of COBOL
  - 18 programs
  - 11924 business rules
  - 9292 identifiers
  - 2823 paragraphs
- **Database generation**
  - 4h for generation for extracting all business rules and indexing

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Visualization

- **Large amount of data**
  - 18 programs
  - 11924 business rules
- **Business analysts**
  - Main artefacts are requirements
- **Need for locating relevant information to users**
  - System wide navigation
- **Recent studies [Ko and al. 2006]**
  - flexible navigation is a key element for software maintainers

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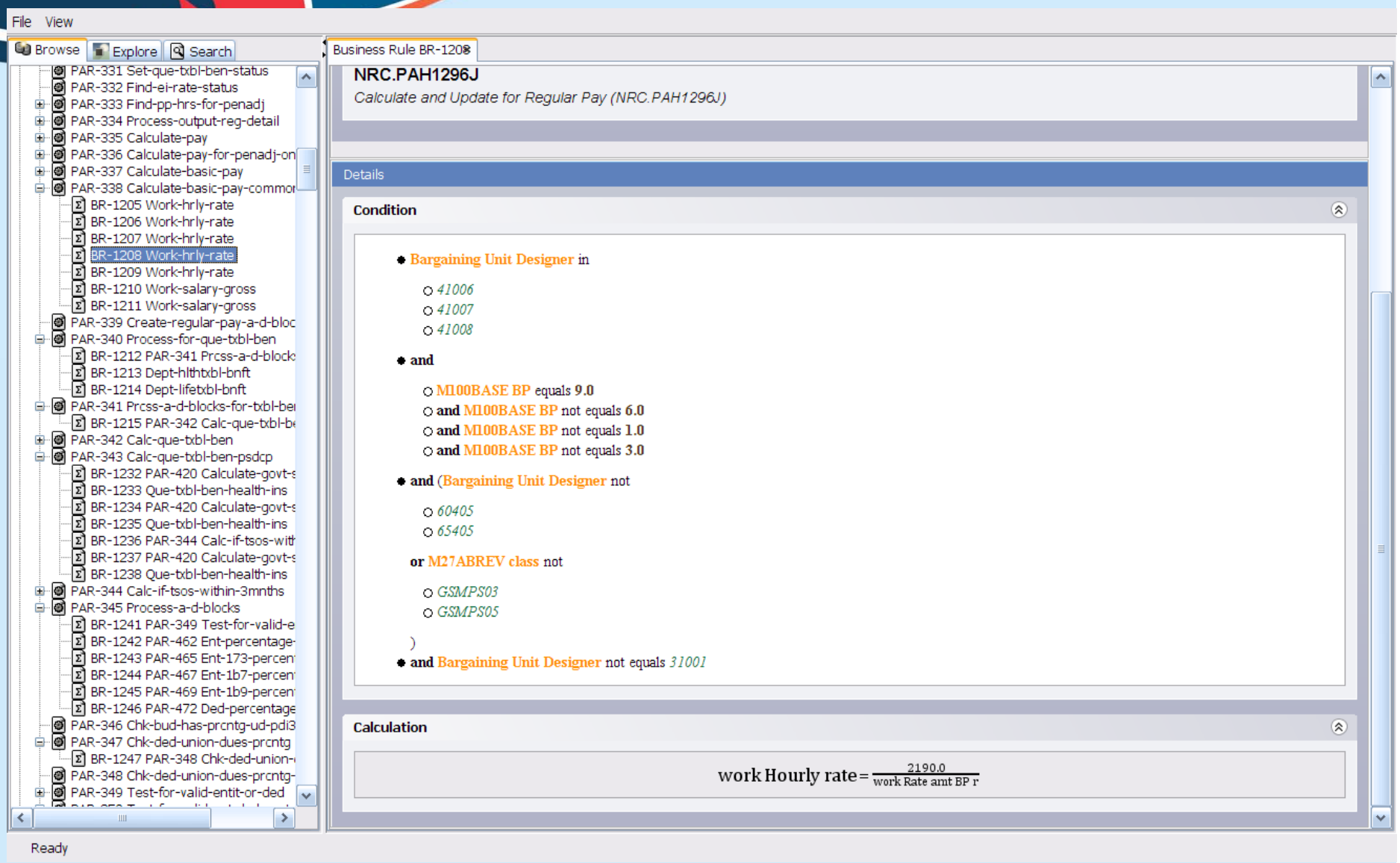
Main User Interface



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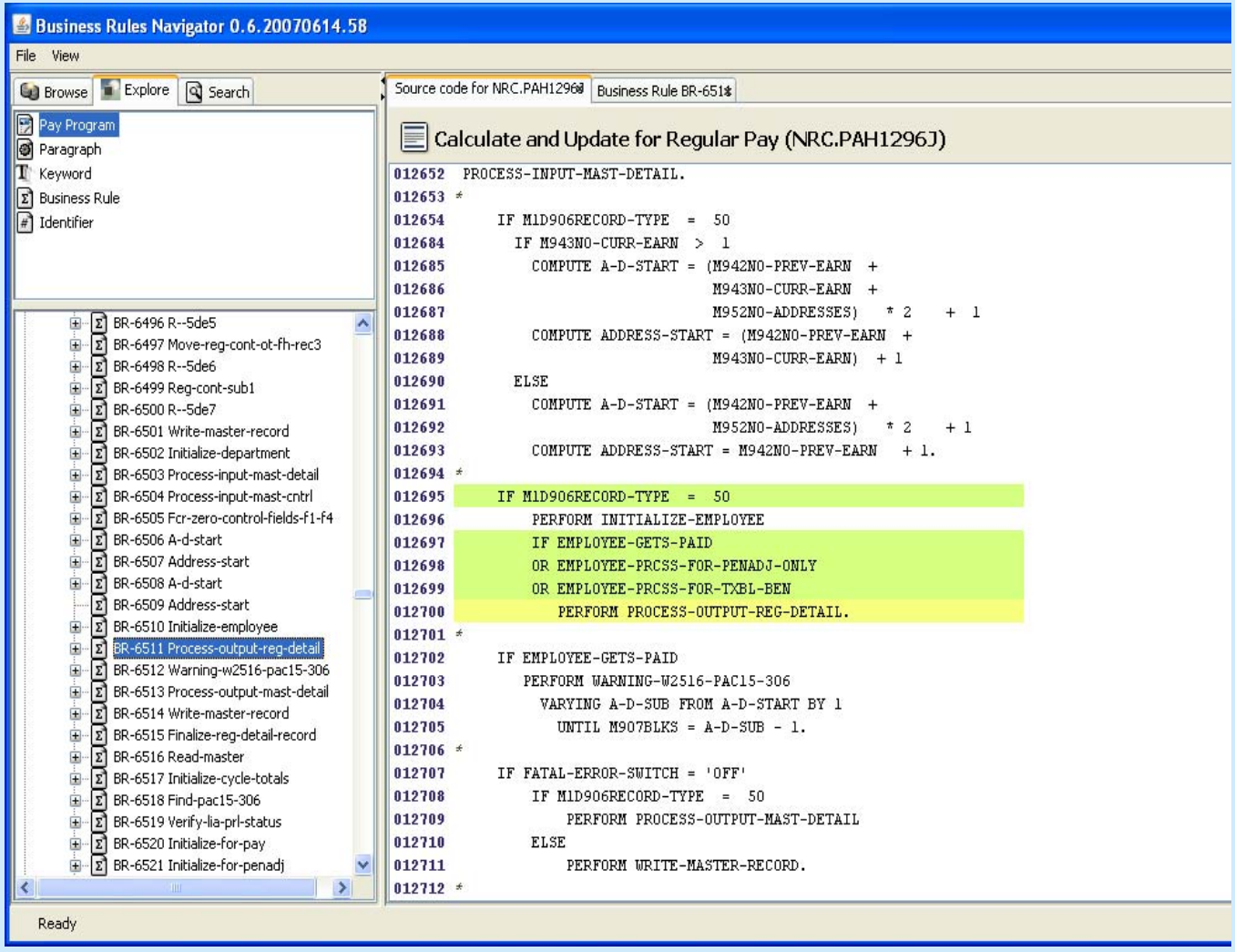
Business rules and source code linking



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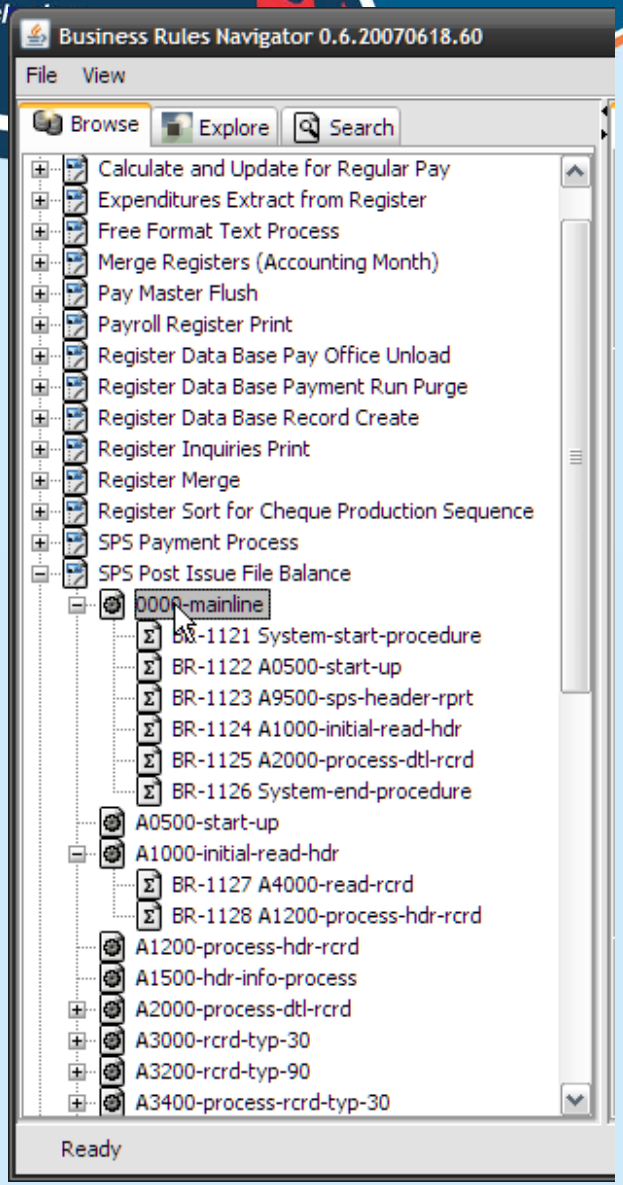
Basic navigation



- **Hierarchical navigation**
  - Programs
  - Paragraphs
  - Business Rules

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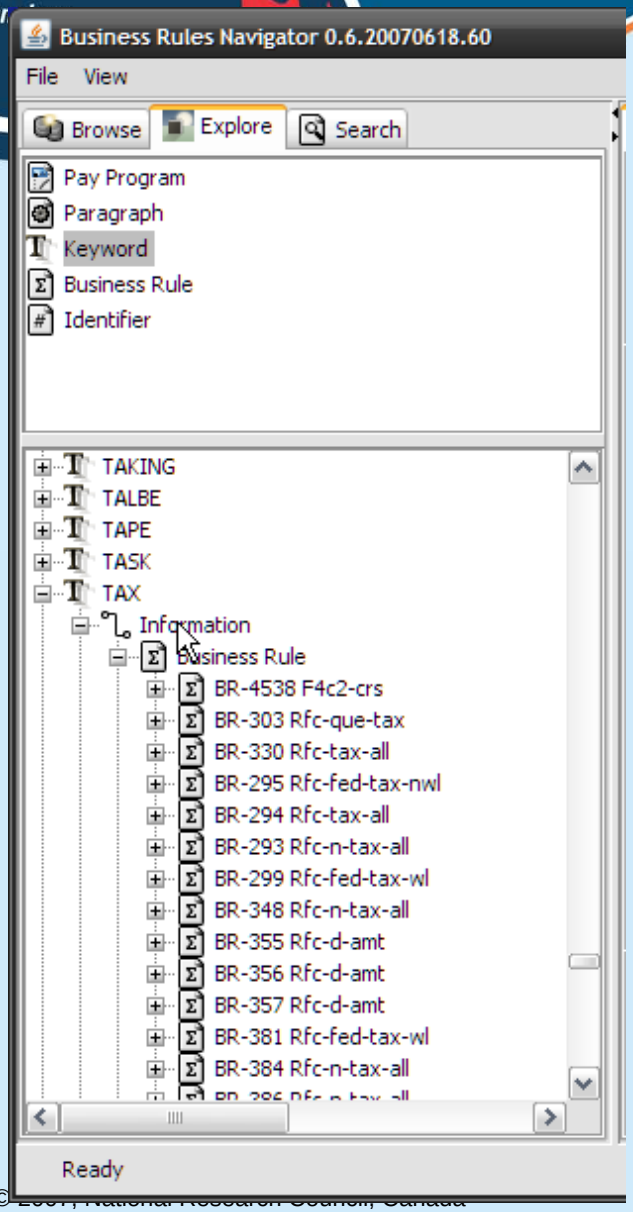
System wide navigation



- **Keyword indexing**
  - Identifiers, comments and COBOL locations are converted to keywords and indexed

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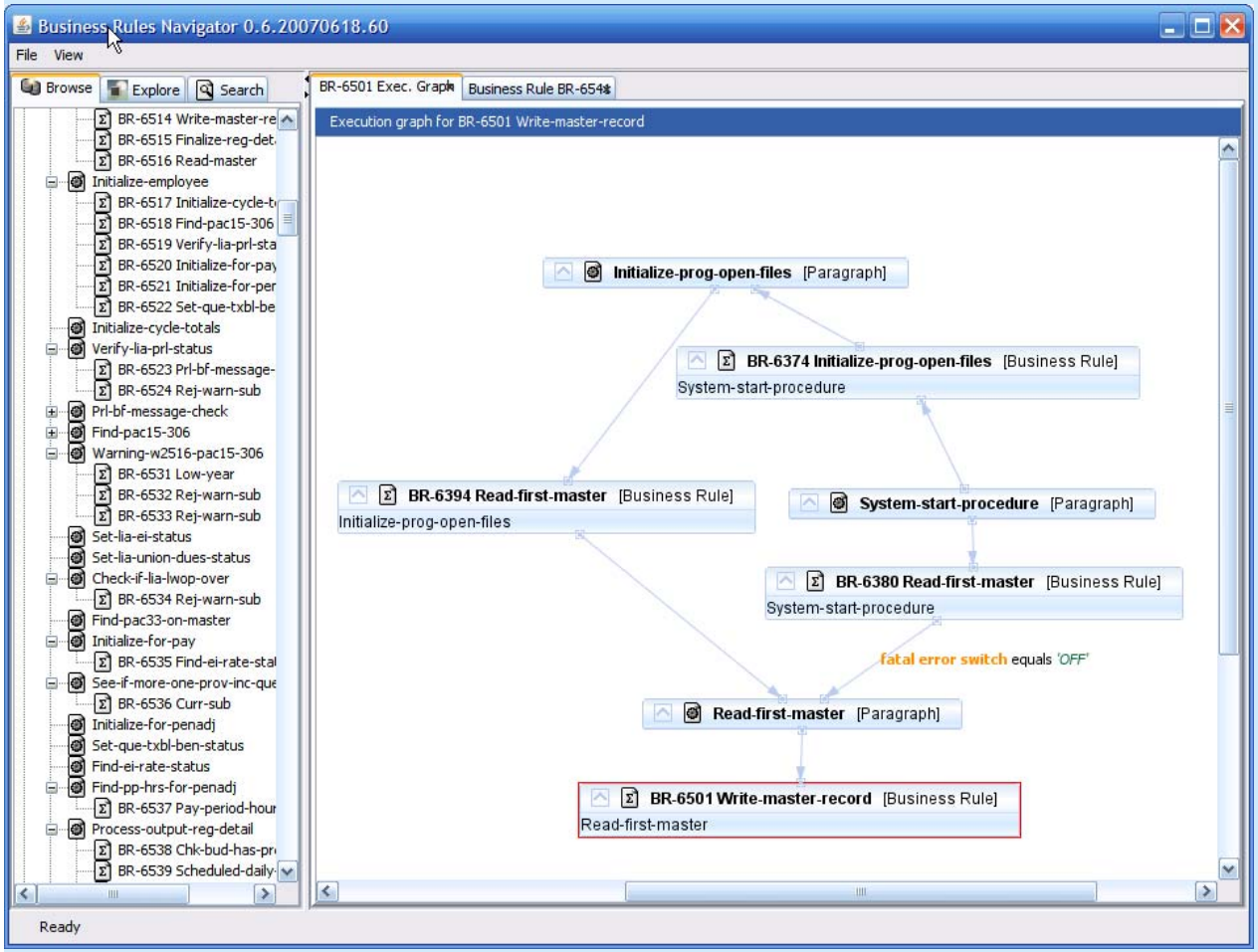
Execution path and dependency visualization



- **Show all paths leading to the execution of one Business Rule**

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Conclusions

- **Business Rules: major element in legacy software modernization**
  - For system maintainers and business analysts
- **Possible to extract business rules from legacy source code**
- **Novelty**
  - output is targeted at business analysts
  - the business rules translated into non-technical terms.
- **Positive early feedback from business analysts about the value and understandability of the information extracted**

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Future

- **Simplified information about branching and loops**
- **Integrate the documentation into the system**
  - Link all elements of the database with existing documentation
- **Data flow analysis**
  - From a generated report of the legacy system, locate all related business rules and calculations
  - State analysis through the execution flow for connecting variables to documented data sources