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Workflow, Rule, and Optimization Engines:
Working Together,
Jacob Feldman, PhD

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- Modern document-intensive business processes require the integration of multiple technologies in a single practical solution. In particular:

    - **Workflow** Engine

        - to define and execute a business process

    - **Rule** Engine

        - to define and execute business logic

    - **Optimization** Engine

        - to find an optimal solution for the business problem

- Claims processing, loan origination, service configuration, insurance policy management are typical examples of the complex document-intensive business processes
- Workflow engines are used to design and execute such processes
- They provide necessary tools to capture, process, route, and archive documents and associated information needed to successfully complete document management
- However, a pure workflow technology itself is missing automatic decision support capabilities

- Business rules management frameworks have already proved their efficiency for rules representation, maintenance, and execution

- At the same time, business rules are always attached to a business process

- So, it is natural for business rules to be used to create decision support workflow nodes. Such nodes can control the workflow logic, generate and redirect workflow items

- A typical workflow engine allows customers to:
  - Make sense of the *flood of unstructured information* that enters the enterprise
  - Provide the right information, to the right person, at the right time, to get the job done -- *right*

- Example: Exigen Workflow Framework
  - Provides a consistent Workflow methodology for both knowledge-based and administrative jobs regardless of:
    - Location
    - Customer interaction channel
    - Task
    - Role
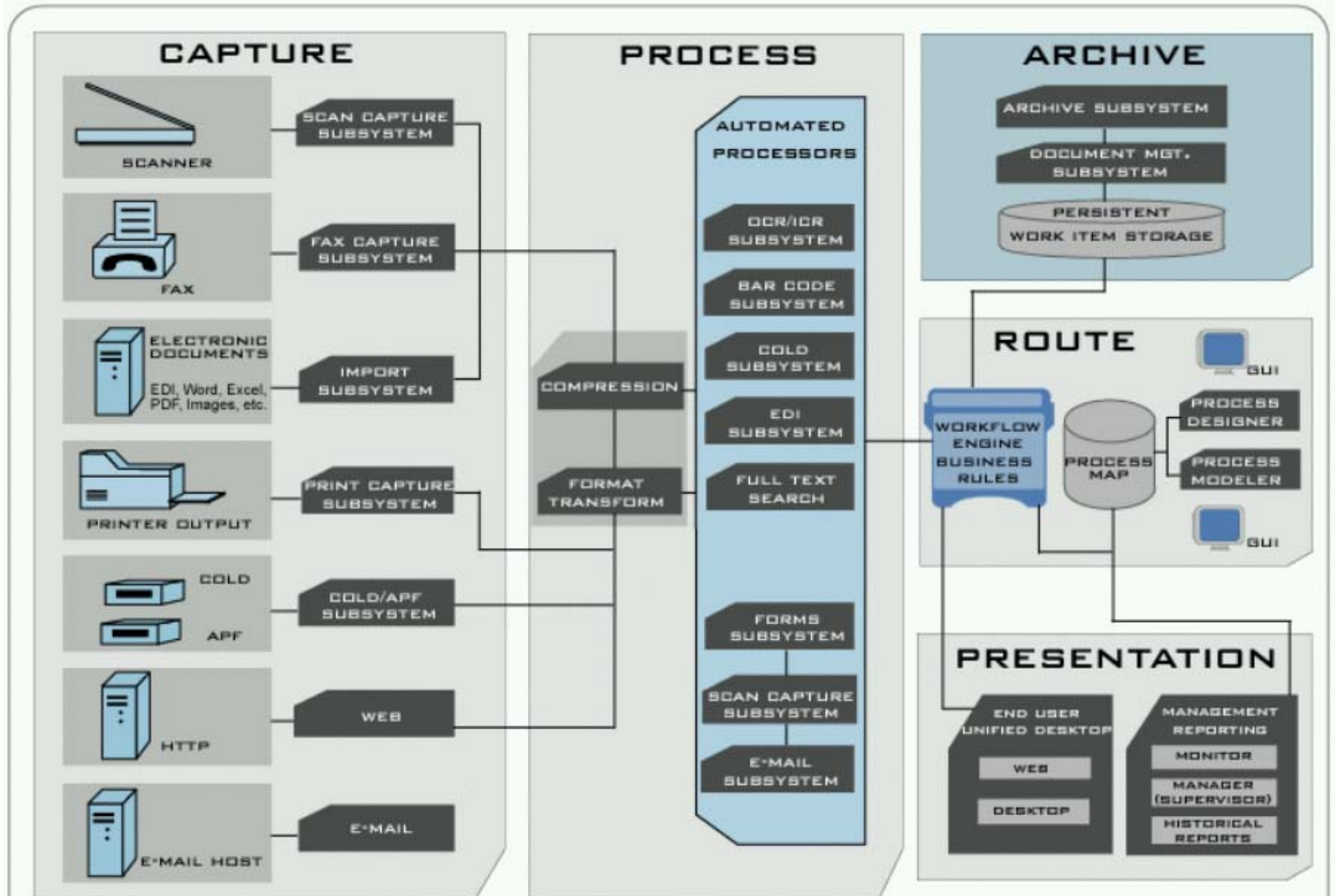
- **Scanning**
- **Inbound Fax**
- **Outbound Fax**
- **Document Formats**
- **Imaging**
- **OCR/ICR**
- **Bar Code**
- **COLD**
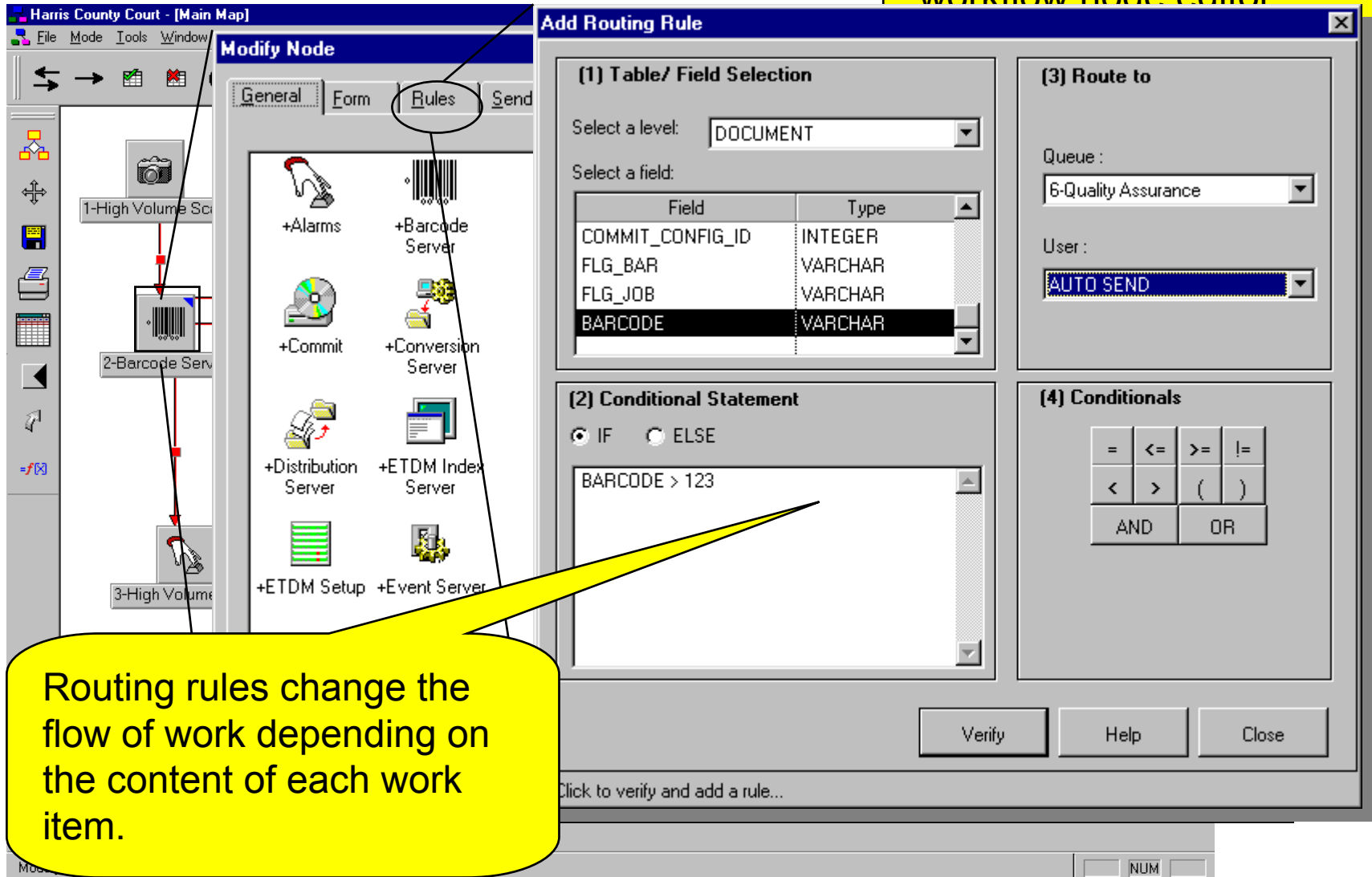- **Non-Structured Data Archives**
- **Repository database**

- Design work processes using visual tools – Workflow Designers

- Create complex <u>routing</u> rules using "drag & drop"

- Route work items to user groups or automated processors

- Manage data flow through legacy (core business systems) environments

- Monitor and report on business processes; escalate and alarm business bottlenecks

- Centralize into one location or distribute work to branch organizations

- **Skills-based Routing**

  – Knowledge worker abilities matched to item requirement

  – Approval and QA automation

- **Context-based Routing**

  – Customer segmentation

  – Item difficulty

  – Location of customer or issue

- **Workload-based Routing**

  – Named User, Push, and/or Pull Metaphors

- **Audit log and tracking**

For each work item, the workflow node editor

Harris County Court - [Main Map]

File Mode Tools Window

1-High Volume Sc

2-Barcode Serv

3-High Volume

Modify Node

General Form Rules Send

+Alarms +Barcode Server

+Commit +Conversion Server

+Distribution Server +ETDM Index Server

+ETDM Setup +Event Server

Add Routing Rule

(1) Table/ Field Selection

Select a level: DOCUMENT

Select a field:

Field	Type
COMMIT_CONFIG_ID	INTEGER
FLG_BAR	VARCHAR
FLG_JOB	VARCHAR
BARCODE	VARCHAR

(2) Conditional Statement

○ IF   ○ ELSE

BARCODE > 123

(3) Route to

Queue :

6-Quality Assurance

User :

AUTO SEND

(4) Conditionals

=	<=	>=	!=
<	>	(	)
AND		OR	

Verify   Help   Close

Click to verify and add a rule...
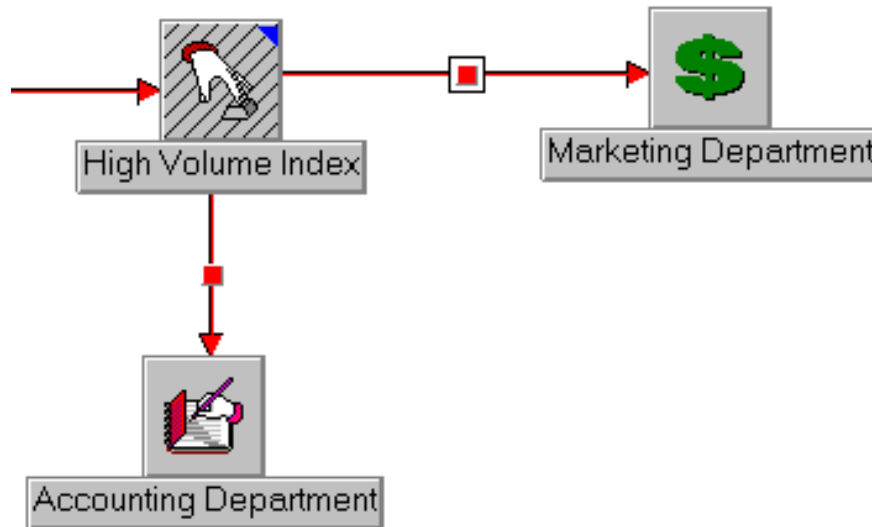
Routing rules change the flow of work depending on the content of each work item.

NUM

- # Events

- Insurance
  - Underwriting
  - Claims processing
  - Agency automation (B2B Sell Side automation)
- Finance
  - Loan origination
  - Credit Card Issuance and processing of payments
  - Broker automation
  - Front Office automation
    - Signature Card Authorization
  - Account management

- General business
  - AR/AP
  - HR
  - Document Enabling SAP
  - Doc Archival/Retention
- Government
  - Records Management
  - Web-based Constituent access
  - License Renewals
  - Accident Reporting
  - State Insurance Dept
  - Law Enforcement
  - Court Case Management
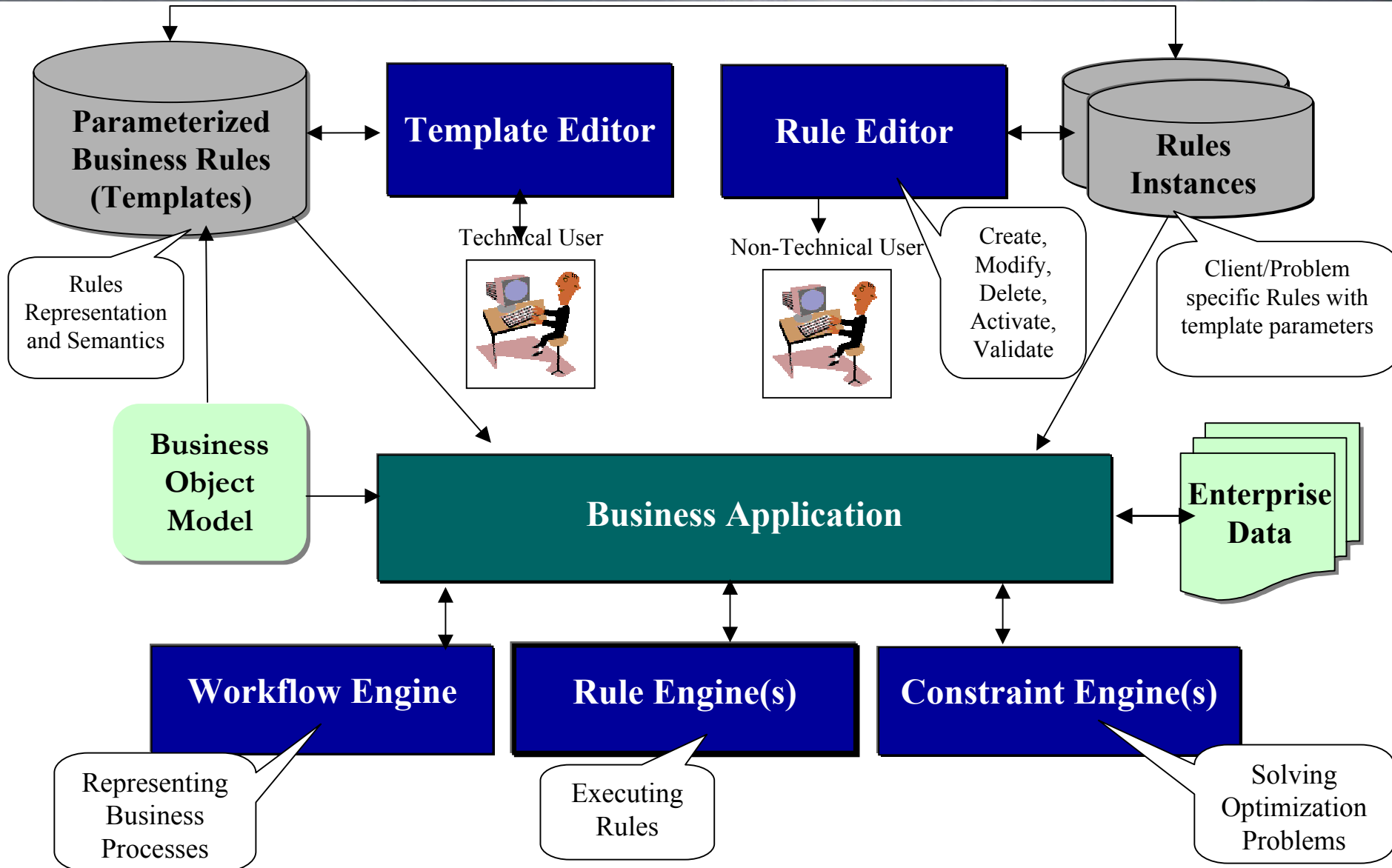 - Public Access to Board Agenda
  - Tax Records

- A powerful framework for the rapid creation, deployment, and maintenance of business rule management systems

- Externalizes business rules from application code

- Allows <u>business people</u> to create/modify/deploy business rules

- Provides customers with a <u>methodology and tools</u> for building industry specific rule templates which in turn are used to create, test and maintain a diverse hierarchy of inter-related rules.

- Creation of thousands of semantically equal rules, instead of hundreds of templates (!)

- No consideration of the lifecycle of rules

- Absence of the rules consistency validation tools (!)

- Attempts to cover ALL possible business situations with rules instead of applying optimization technology(!)

- Do not invent: reuse LOB-specific template libraries built on top of LOB-specific standards (ACORD,MISMO,..)

- ## Template-based Rules Repository:

  - During rules harvesting classify *semantically similar rules* into templates

  - Real-life example: using the template technology, a Wall Street institution combined more than 3000 portfolio management rules into less than 300 templates

  - Define complex relationships between template parameters

- ## Simplified Maintenance:

  - Rules semantics kept only in a library of hundred templates supported by specialists, while thousands rules are supported by business users themselves.

  - Administrative roles accessing template and rule sets.

Rules-based Application with Three Engines: Functional Scheme

Parameterized Business Rules (Templates)

Template Editor

Rule Editor

Rules Instances

Rules Representation and Semantics

Technical User

Non-Technical User

Create, Modify, Delete, Activate, Validate

Client/Problem specific Rules with template parameters

Business Object Model

Business Application

Enterprise Data

Workflow Engine

Rule Engine(s)

Constraint Engine(s)

Representing Business Processes

Executing Rules

Solving Optimization Problems

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APPLICATION **PRODUCT CONFIGURATOR**

Home Equity

- PRODUCT GROUPS
- Home Equity
  - 80% HELOAN
  - 90% HELOAN
  - 110% HELOAN
  - 100% HELOC
- Small Business
- Mortgage

Print table

Save

	80% HELOAN	90% HELOAN	110% HELOAN	100% HELOC
Available Terms				
Available product terms	120	12,24,48,60,84,120	12,24,48,60,84,120	12,24,48,60,84,120
Base Offers Parameters				
Margin by terms	Loan Term List:120 Margin:2.00	Loan Term List:12,24,48,60,84,120 Margin:1.00	Loan Term List:12,24,48,60,84,120 Margin:1.00	Loan Term List:12,24,48,60,84,120 Margin:1.50
Base Rate	Loan Terms:120 Base Rate:7.00	Loan Terms:12,24,48,60,84,120 Base Rate:7.00	Loan Terms:12,24,48,60,84,120 Base Rate:7.00	Loan Terms:12,24,48,60,84,120 Base Rate:7.00
Loan Limits by Terms	Loan Term List:120 Loan Min:20,000.00 Loan Max:100,000.00	Loan Term List:12,24,48,60,84,120 Loan Min:20,000.00 Loan Max:250,000.00	Loan Term List:12,24,48,60,84,120 Loan Min:20,000.00 Loan Max:250,000.00	Loan Term List:12,24,48,60,84,120 Loan Min:20,000.00 Loan Max:250,000.00
Eligible Property Types	Single Family Detached,Condominium	Single Family Detached	Single Family Detached,Condominium	Single Family Detached
Min FICO	561	600	750	444
Closing cost				
Max DTI (Debt-To-Income)	55.00	60.00		50.00
Max LTV (Loan-To-Value)	80.00	90.00	110.00	100.00
Requirements				
Income Verification	W2 1 year, Pay Stubs 45 days, Employer Ltr			Previous Year W2 Pay Stubs 45 days
Signature	eSignature OK	eSignature OK	eSignature OK	Signature Needed
Appraisal Unconditional	Electronic	Electronic		Full Appraisal Needed
Appraisal by Age			Appraisal Requirement:New Appraisal Required Days:300	
Title	Title Insurance Needed	Title Insurance Needed		Title Search Needed

- Right rules organization, application of only necessary rules and rule engines
- Embracing different Inference engines:
  - Rete-based engines like JESS™ or ILOG™
  - Highly efficient inference engine based on new algorithms from parallel rules languages
- Multiple inter-dependent engines:
  - light-weight
  - re-entrant
  - scalable
- Configurable Run and Test components

- Ability to define and solve constraint satisfaction problems. Automatic formulation of optimization problems in rules and solving them with a built-in constraint engine

- Hard and Soft Rules

- Minimization of the total rule violations

- Rules Consistency and Coherence validation
  - Diagnose rules overlapping and under-covering
  - This feature is particularly important for complex classification rule tables that go far beyond simple if-then statements

- Rules themselves cannot describe ALL possible business situations and recommend the best solution

- Apply Optimization engine each time there are multiple alternatives and looking not for **a** solution, but for the **best** solution

- Integrate Rule Engine with different Optimization Engines (constraint-based, linear, other)

- Add sophisticated decision-support capabilities by applying the optimization engine against different optimization objectives defined in rules

- Integer, boolean, and floating point constrained variables

- All basic constraints and constrained expressions

- Generic reversible environment with highly efficient event notification and constraint propagation mechanisms

- Interpreter of symbolic constrained expressions

- Powerful pre-defined search algorithms (goals)

- Ability to write problem-specific constraints and search algorithms

- Built-In integration with rules frameworks

- Implementations in C++ and Java

- Ability to represent rules as constraints

- Use of both rules and constraint programming techniques inside the same framework to solve complex business problems that usually out of reach of regular rule engines

- Real-world examples

- # Financial Portfolio Management

  - Use rules like "Technology Stocks should be within 20% and 35%" to define the target portfolio

  - Objective: keep all actual portfolios as close as possible to the target portfolio

- # Integrated Engines:

  - Rule Engine warns about possible rule violations during sell/buy

  - Constraint Engine recommends the best combination of trade orders to minimize the total rules violation

- ## Loan Origination

  - Applying for a loan, a customer usually provides a desired loan amount, term, and a list of included borrowers with different credit scores

  - Objective: to avoid rejection or lengthy "what-iffing", a bank allows to *"a little bit violate"* the requested parameters to find a loan with the minimal interest rate

- ## Integrated Engines:

  - Rule Engine defines all eligible loan products

  - Constraint Engine recommends the best combination of the loan amount, term, and borrowers to select the most suitable loan product

- ## Telecom Service Configuration

  - Personalized configuration of available calling plans and other wireless, local, long distance and Internet services

  - Rules-based marketing campaigns

- ## Integrated Engines:

  - Rule Engine determines cross/up selling opportunities

  - Rule Engine warns about possible rule violations

  - Optimization Engine recommends the best set of services that fit a customers' preferences and actual calling pattern

  - Rule and Optimization Engines work together with customer data to determine and deliver the best account management advice to the CSR desktop

- **Insurance Pricing Discount Calculation**

  - According to the specified business rules, the customer is eligible to N different discounts

  - There is a rule/constraint that states that the total discount cannot be more than x%.

  - Objective: find a combination of the discounts that satisfies the "x%" constraint while maximizing/minimizing the premium

- **Integrated Engines:**

  - Rule engine figures out all eligible discounts

  - Optimization engine finds the best alternative for customer and company

- Hybrid use of rules and constraint technologies:

  > Rule Engine + Constraint Engine=
  >
  > Online Decision Support

- Use Rules

  – to define and modify the business problem

- Use Constraints

  – to solve the optimization problem

- Workflow, Rules, and Optimization are powerful by themselves

- Integration in couples "Rules+Optimization" or "Workflow+Rules" produces valuable results

- Real efficiency when all three are combined

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          - theft
          - dwelling
          - title
          - flood
          - riot
          - earthquake
      - Commercial Lines of Business
        - Workers' Compensation
        - commercial Automobile
        - commercial Property
        - other
  - Life and Health
    - Life and Health
      - personal Lines of Business
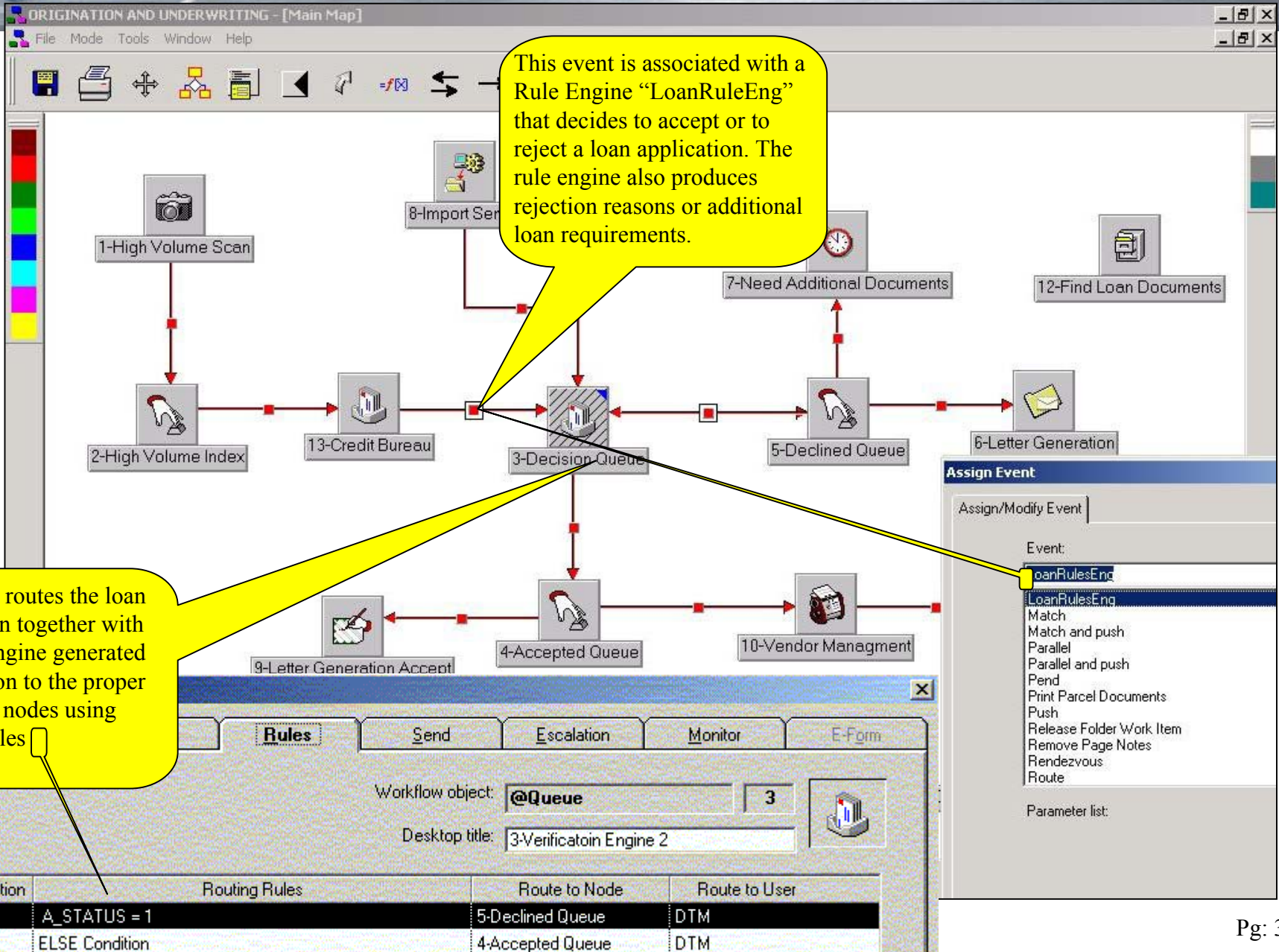   - life
        - long Term Care
        - medical

- • The following are excerpts from a Business Process Library for insurance policy servicing for private passenger auto:
  - Incoming Requests
  - Inquiries
  - Endorsements
    - • Change Vehicle
    - • Add Driver
    - • Add Vehicle
  - Rate Policy
  - Renewal
  - Follow-up

- **Policy**:
  - Mr.S drives a 1999 Lexus, Mrs. S drives a 1997 Acura, and their 17 year old son occasionally drives his mother's Acura

- **Customer Request:**
  - Mrs. S trades in her Acura for a new Mercedes

- **Possible Consequences:**
  - The son used to be assigned to the Lexus as the riskiest driver for a car with the highest exposure
  - Now the Rule Engine gives the Mercedes the highest exposure
  - The Rule Engine assigns the son to the Mercedes
  - Their overall premium goes up to $XXX and the appropriate rule requires a copy of the registration for the Mercedes . The Workflow Engine generates a new workitem to request the registration. The workitem will be escalated if the registration is not received within 4 days
  - If all of this occurred on December 27th, and new rating rules are scheduled for January 1st, this process may be repeated

- Previous process is an example of how Workflow engine works together with Rule and Constraint engines

- There are several logically connected processes:
  - Receive Customer Request (workflow service)
  - Receive Existing Insurance Policy (workflow service)
  - Recalculate Vehicle Exposures (rule service)
  - Reassign Drivers to Vehicles (rule service)
  - Recalculate Premium (rule and optimization services)
  - Generate and Fax Back Confirmation (workflow service)
  - Escalate (workflow service)
  - Follow-Up (workflow service)

This event is associated with a Rule Engine "LoanRuleEng" that decides to accept or to reject a loan application. The rule engine also produces rejection reasons or additional loan requirements.

This node routes the loan application together with the rule engine generated information to the proper workflow nodes using routing rules

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- Associate Rule/Constraint Engines with workflow nodes to receive/produce/modify workflow items

- Use Rules/Constraints to define status and other variables of the workflow items

- Rule Engine can initiate workflow actions (e.g., send fax or email, put on hold, escalate), but should not execute them directly

- Use workflow Routing rules (not business rules!) to route the workflow items

- Treat Rules and/or Optimization Engines as Workflow Services

- The Exigen Framework automates document-intensive business processes through the use of three integrated intelligent engines:

  – **A Workflow Engine** to define and execute a business process

  – **A Rule Engine** to define, maintain and execute business rules

  – **An Optimization Engine** to find optimal solutions to business problems

Jacob Feldman, Ph.D.

jacob_feldman@exigengroup.com

732-248-8965 NJ office
732-306-0685 cell

www.exigengroup.com