Business Decision Modeling with DMN and OpenRules

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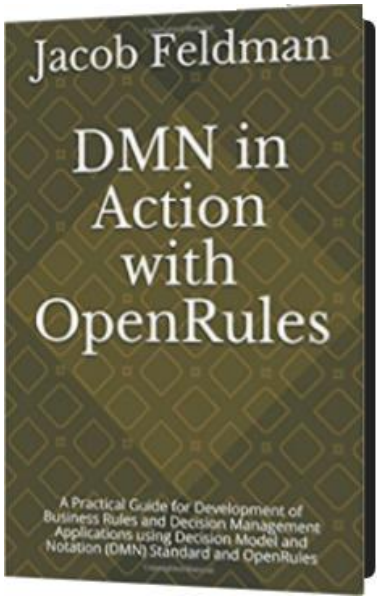

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Outline

- DMN
- Hands-on creation and execution DMN-based decision models
  - DecisionHello (by business analysts)
  - DecisionHelloJava (integration with IT)
  - DecisionLoanOrigination
  - Domain-Specific Decision Tables

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Business Rules and Decision Management Systems (BRDMS)

- BRDMS is at the center of modern enterprise architectures
- Examples: loan approval, insurance underwriting, customer service tactics, clinical guidelines, risk management, compliance, and many others
- **Still**:
  - decision logic has to be defined by humans
  - semantic technology can make a difference

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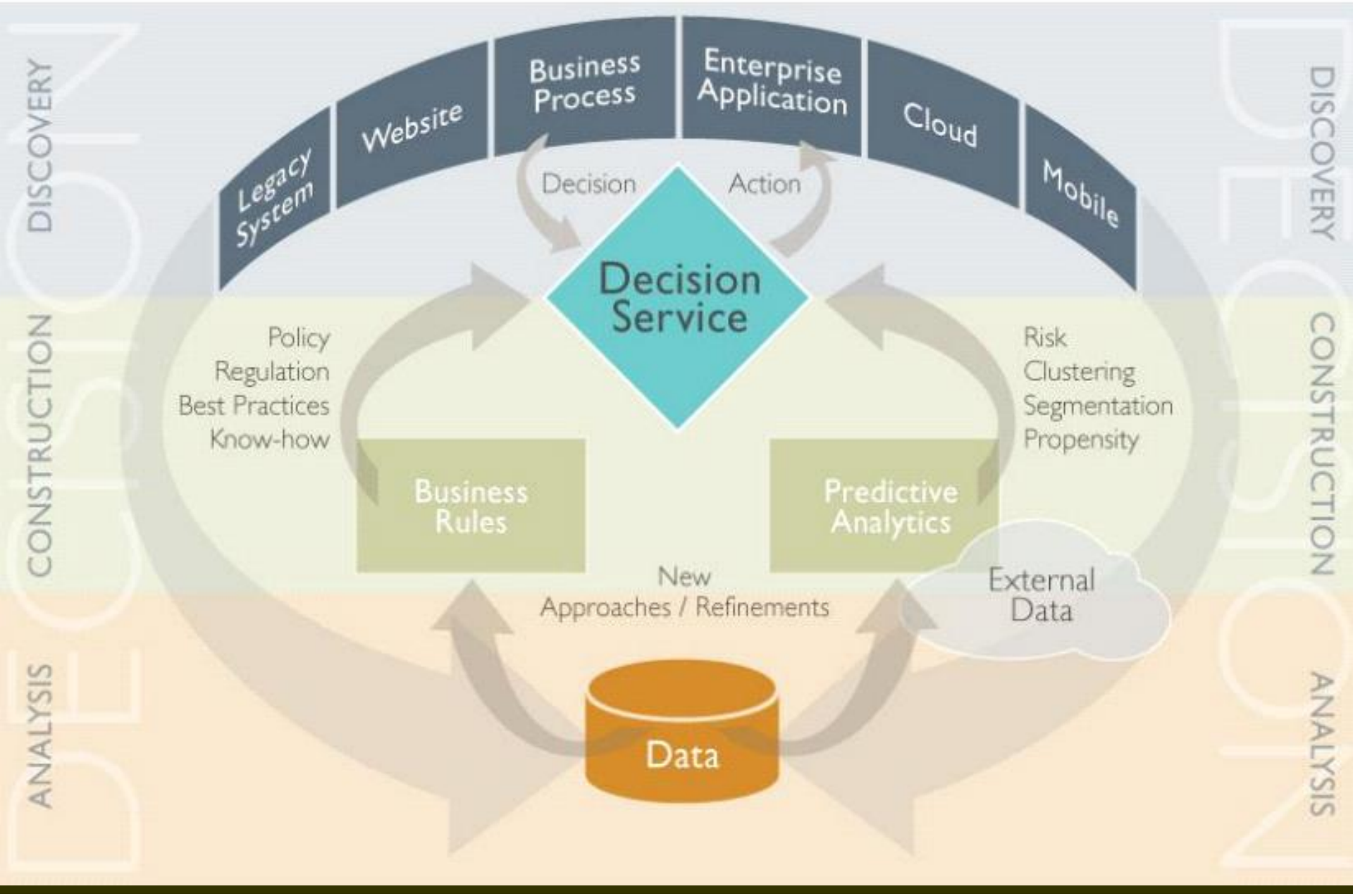
Decision Services at the center



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DMN – Decision Model and Notation

- OMG standard since 2014
- Specifies key concepts and constructs for business decision modeling
- Current release 1.1 supports DMN XML interchange format
- Next Release 1.2 – Q1 2018
- Many vendors announced DMN support

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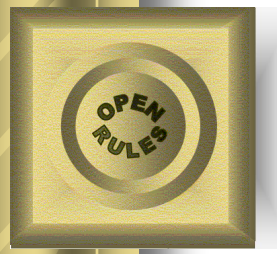

DECISION MANAGEMENT COMMUNITY

Shared Information Sources for Decision Management Practitioners

www.DMCommunity.org

Decision Model and Notation (DMN) Supporting Tools

#	Product	Select
1	AlfrescoActiviti	☐
2	Avola	☐
3	BiZZDesign	☐
4	Blueriq	☐
5	Camunda	☐
6	DecisionsFirstModeler	☐
7	Drools	☐
8	FICO	☐
9	FlexRule	☐
10	IDIOM	☐
11	OneDecision	☐
12	OpenRules	☐
13	RapidGen	☐
14	Sapiens	☐
15	Signavio	☐
16	Sparkling Logic	☐
17	Trisotech	☐

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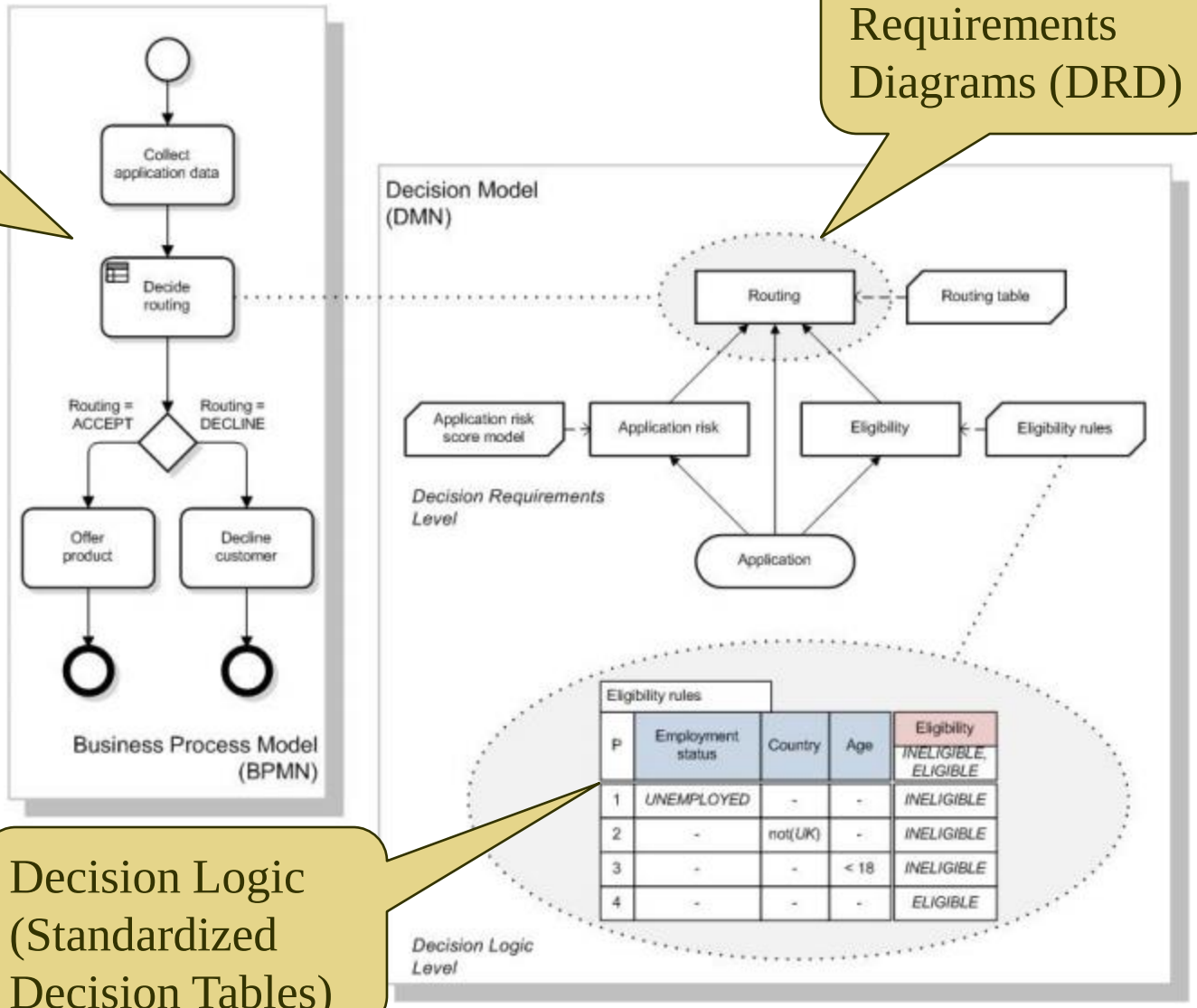
DMN Modeling Aspects

Integration with Business Processes (BPMN)

Decision Requirements Diagrams (DRD)



Decision Logic (Standardized Decision Tables)

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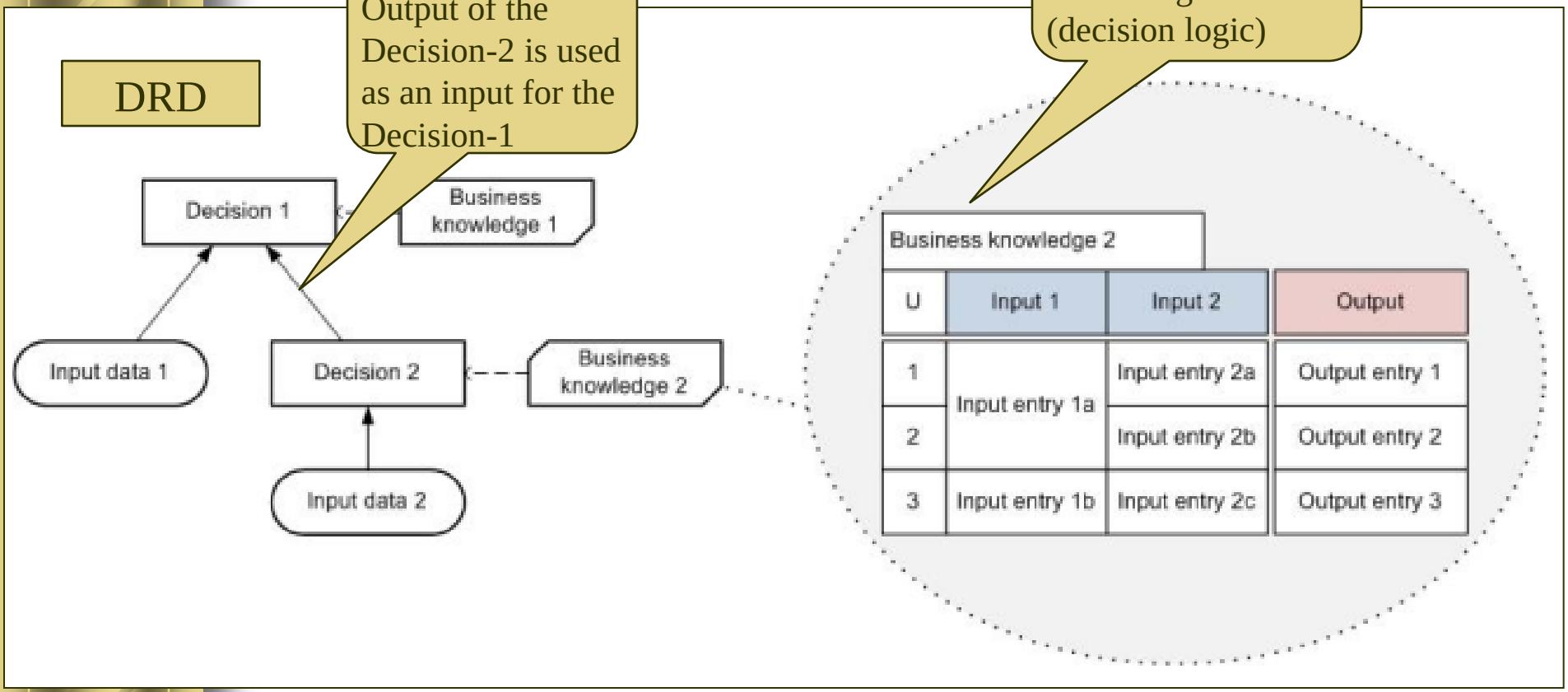
DMN Notation



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Decision Modeling Constructs

- Core Constructs
  - Diagrams with Logical Connections (information requirements)
  - Decision Tables
  - Basic Expression Language (S-FEEL)
  - Conformance Level 2
- Advanced Constructs
  - Boxed Expressions (FEEL functions with parameters, contexts, if-then-else, for..return loops, filters, sorting, recursion, …)
  - Conformance Level 3

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Hands-On Decision Modeling

- The best way to understand DMN is to build and test real Decision Models
- We will create and execute several examples:
  - DecisionHello (by business analysts)
  - DecisionHelloJava (integration with IT)
  - DecisionLoanOrigination

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Sample Decision Model "Determine Customer Greeting"

- Decide how to greet a particular customer during different times of the day (think IVR)
- Test:
  - Customer: Robinson is a married woman
  - Time of the day: 14:25 pm
  - Expected decision: "*Good Afternoon, Mrs. Robinson!*"

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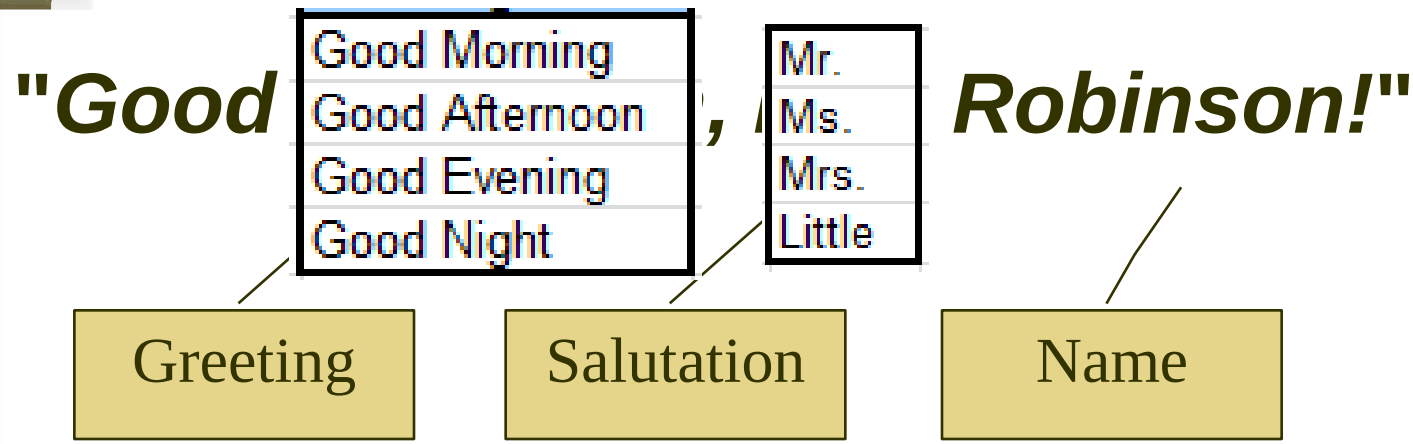
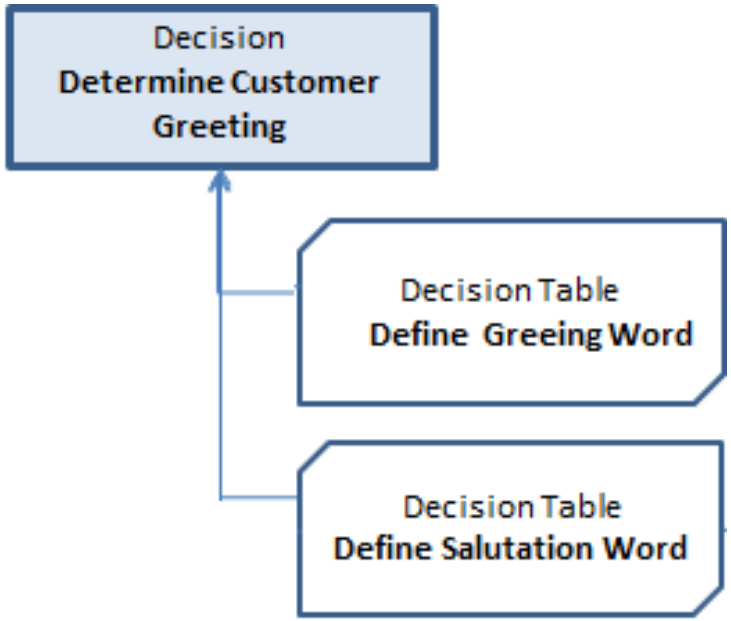
Starting with a Decision





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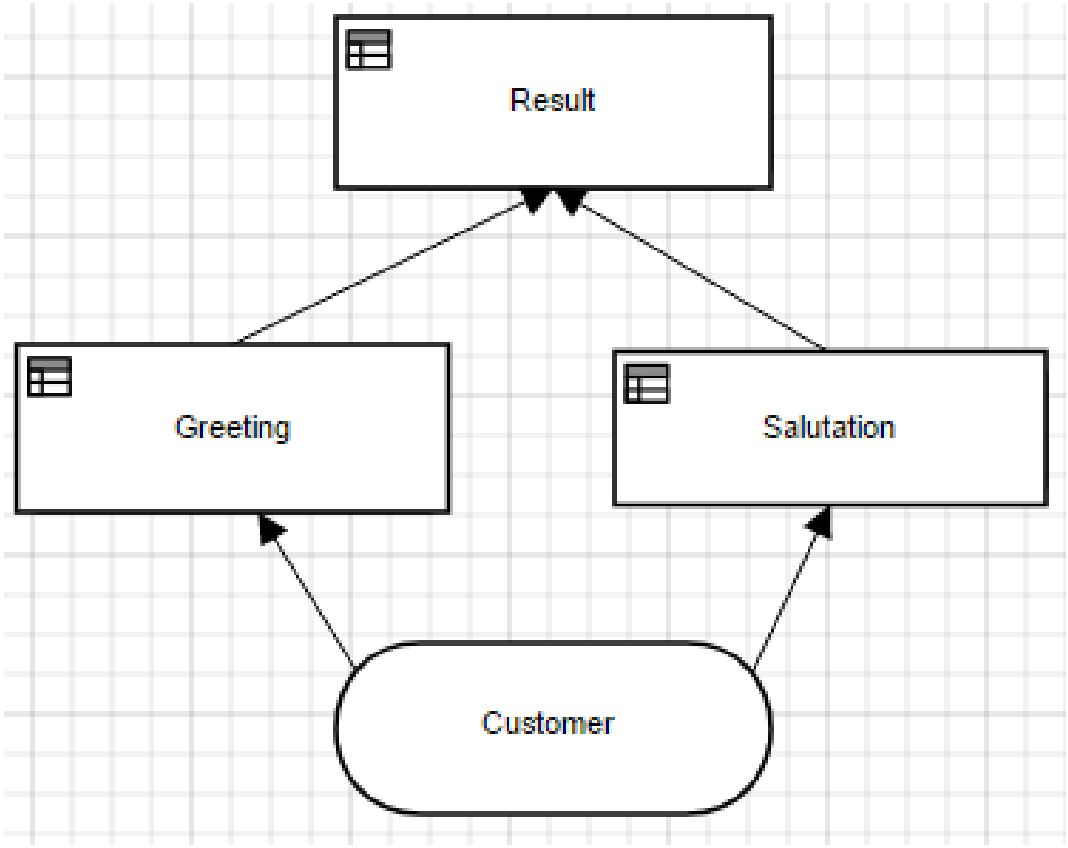
Decision Requirements Diagram



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DRD as a Tabular Decision

- It is a well-known fact that any diagram can be presented in a tabular format (see e.g. Shlaer-Mellor method)
- Our DRD may be presented in OpenRules as

Decision DetermineCustomerGreeting	
Decisions	**Execute Decision Tables**
Define Greeting Word	DefineGreeting
Define Salutation Word	DefineSalutation
Define Resulting Greeting	DefineResult

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Decision Table "DefineGreeting"

DecisionTable DefineGreeting	
If	Then
Current Hour	Greeting
[0..11)	Good Morning
[11..17)	Good Afternoon
[17..22)	Good Evening
[22-24]	Good Night

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Decision Table "DefineSalutation"

DecisionTable DefineSalutation		
If	If	Then
Gender	**Marital Status**	**Salutation**
Male		Mr.
Female	Married	Mrs.
Female	Single	Ms.

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Decision Table "DefineSalutation" (alternative representation)

DecisionTable DefineSalutation					
Condition		Condition		Conclusion	
Gender		Marital Status		Salutation	
Is	Male			Is	Mr.
Is	Female	Is	Married	Is	Mrs.
Is	Female	Is	Single	Is	Ms.

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Decision Table “DefineResult”

DecisionTableAssign DefineResult	
Variable	**Value**
Result	Greeting + ", " + Salutation + Name + "!"

- This is an examples of a simple FEEL expression

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Defining Business Glossary

Glossary glossary		
Variable	**Business Concept**	**Attribute**
Name	Customer	name
Gender		gender
Marital Status		maritalStatus
Current Hour		currentHour
Greeting		greeting
Salutation		salutation
Result		result

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Defining Test Data (in Excel)

Datatype Customer	
String	name
String	gender
String	maritalStatus
int	currentHour
String	greeting
String	salutation
String	result

Data Customer customers						
name	gender	maritalStatus	currentHour	greeting	salutation	result
Name	**Gender**	**Marital Status**	**Current Hour**	**Greeting**	**Salutation**	**Result**
Robinson	Female	Married	20	?	?	?
White	Male	Single	11	?	?	?
Kaye	Female	Single	22	?	?	?

DecisionTableTest testCases			
#	ActionUseObject	ActionExpect	ActionExpect
Test ID	**Customer**	**Greeting**	**Salutation**
Test 1	:= customers[0]	Good Evening	Mrs.
Test 2	:= customers[1]	Good Afternoon	Mr.
Test 3	:= customers[2]	Good Night	Ms.

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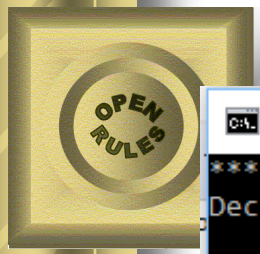
Executing Decision Model



C:\WINDOWS\system32\cmd.exe

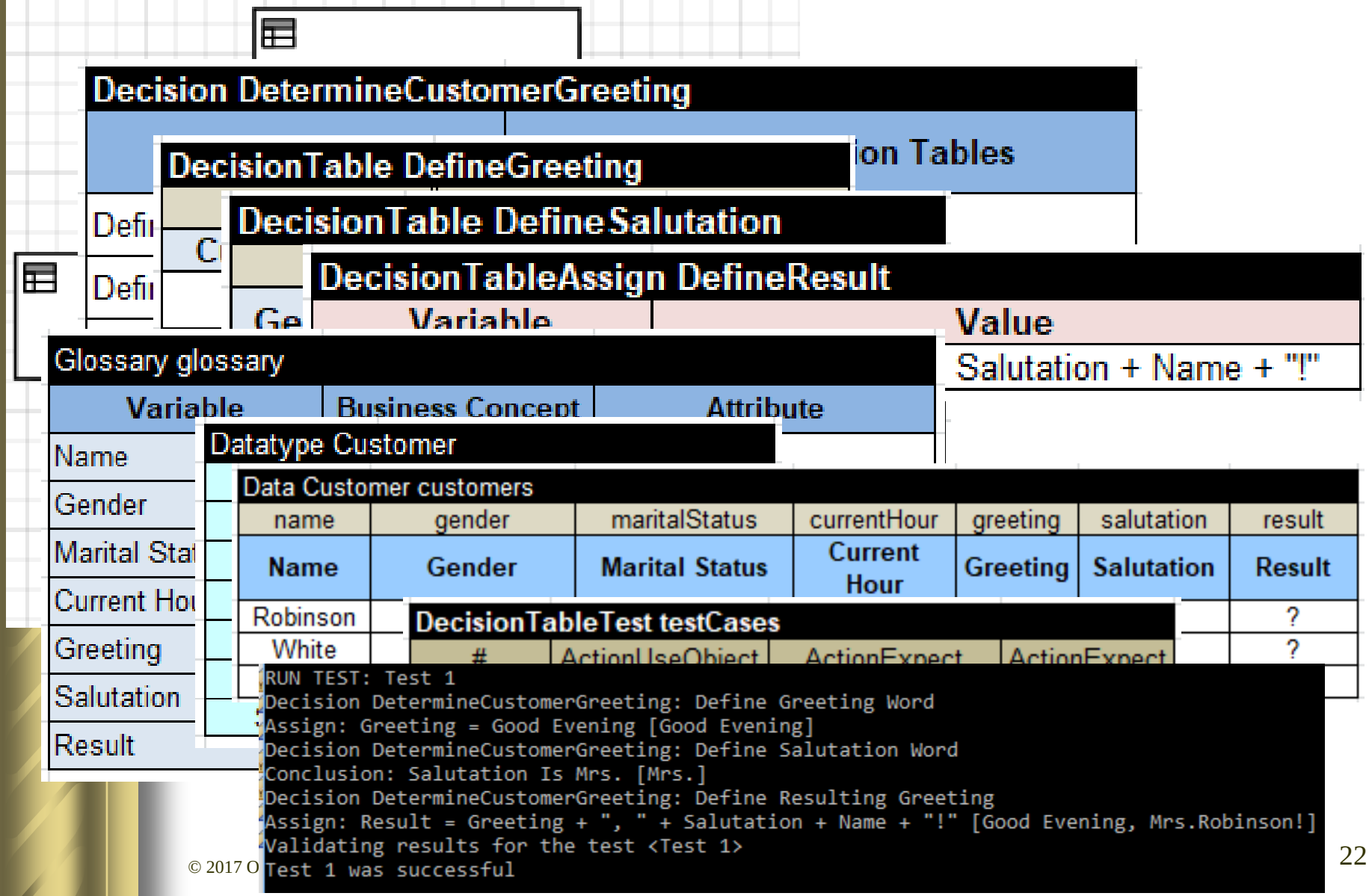
```
*** Decision DetermineCustomerGreeting ***
Decision DetermineCustomerGreeting has been initialized

RUN TEST: Test 1
Decision DetermineCustomerGreeting: Define Greeting Word
Assign: Greeting = Good Evening [Good Evening]
Decision DetermineCustomerGreeting: Define Salutation Word
Conclusion: Salutation Is Mrs. [Mrs.]
Decision DetermineCustomerGreeting: Define Resulting Greeting
Assign: Result = Greeting + ", " + Salutation + Name + "!" [Good Evening, Mrs.Robinson!]
Validating results for the test <Test 1>
Test 1 was successful

RUN TEST: Test 2
Decision DetermineCustomerGreeting: Define Greeting Word
Assign: Greeting = Good Afternoon [Good Afternoon]
Decision DetermineCustomerGreeting: Define Salutation Word
Conclusion: Salutation Is Mr. [Mr.]
Decision DetermineCustomerGreeting: Define Resulting Greeting
Assign: Result = Greeting + ", " + Salutation + Name + "!" [Good Afternoon, Mr.White!]
Validating results for the test <Test 2>
Test 2 was successful

RUN TEST: Test 3
Decision DetermineCustomerGreeting: Define Greeting Word
Assign: Greeting = Good Night [Good Night]
Decision DetermineCustomerGreeting: Define Salutation Word
Conclusion: Salutation Is Ms. [Ms.]
Decision DetermineCustomerGreeting: Define Resulting Greeting
Assign: Result = Greeting + ", " + Salutation + Name + "!" [Good Night, Ms.Kaye!]
Validating results for the test <Test 3>
Test 3 was successful
All 3 tests succeeded!
done
Press any key to continue . . .
```

Implementation Path



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Integration with IT

- Let's assume that now our decision model is tested by business analysts
- How to integrate it with an actual IT application?
  - Business Objects should be mapped to an actual Business Object Model (e.g. Java classes or XML)
  - A decision may be executed directly from an application (using a Java API or a web service)

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Accepting Data From Java

```
public class Customer {

    String  name;
    String  maritalStatus;
    String  gender;
    int     age;
    int     currentHour;
    String  greeting;
    String  salutation;
    String  resul;
```

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Executing Decision From Java

Create a Decision

Create a Customer

Execute the Decision

```
public static void main(String[] args) {

    String fileName = "file:rules/Decision.xls";
    Decision decision = new Decision("DetermineCustomerGreeting",fileName);
    Customer customer = new Customer();
    customer.setName("Robinson");
    customer.setGender("Female");
    customer.setMaritalStatus("Married");
    customer.setHour(Calendar.getInstance().get(Calendar.HOUR_OF_DAY));

    decision.put("customer", customer);

    decision.execute();

}
```

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Mapping Decision Objects

- Simply define business concept Customer as Java object

DecisionObject decisionObjects	
Business Concept	**Business Object**
Customer	:= decision.get("customer")

- IT doesn't even have to look at Decision Logic!
- Glossary is the only integration map between Business and IT

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Decision Modeling: Who Does What

- What Business Users (SMEs) do:
  - **Create** decision models
  - **Validate** decision models
  - Create **Test** cases
  - **Execute** decision models

  SMEs use familiar tools such as Excel or Google Docs (no coding required)
- What Developers do:
  - Help to integrate already tested decision models into existing IT infrastructures

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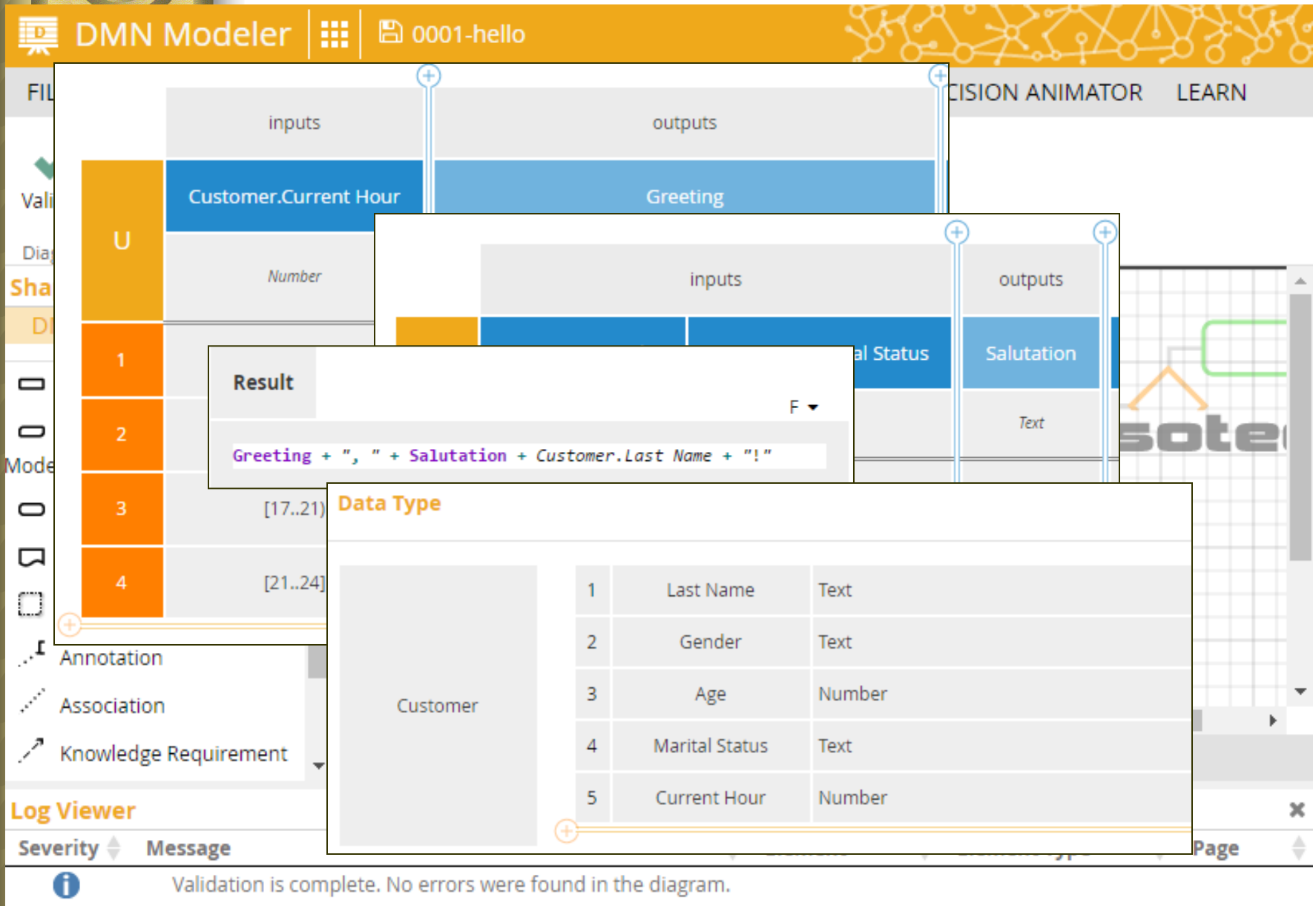
Specialized DMN Modelers



DMN XML Interchange Format

```
<itemDefinition name="Customer" label="Customer">
  - <itemComponent name="Last Name" id="_40976532-8325-486b-917d-5b4a19825ac8">
        <typeRef>feel:string</typeRef>
    </itemComponent>
  - <itemComponent name="Gender" id="_0dd23e8c-4bd4-406d-89eb-524e97495dbd">
        <typeRef>feel:string</typeRef>
    </itemComponent>
  - <itemComponent name="Age" id="_f19c2d42-a4a1-4e54-8e74-c00752112b7e">
        <typeRef>feel:number</typeRef>
    </itemComponent>
  - <itemComponent name="Marital Status" id="_31e0dcc1-28cc-437b-a463-677e41369cf5">
        <typeRef>feel:string</typeRef>
    </itemComponent>
  - <itemComponent name="Current Hour" id="_13eb77cf-bdaf-46b6-afe3-406fef095144">
        <typeRef>feel:number</typeRef>
    </itemComponent>
</itemDefinition>
<decision name="Result" id="_e1f060d6-5153-46d2-8e52-81601a0e5960" triso:displayName="Result">
    <variable name="Result" id="_b5c3a016-732d-49be-b0cd-940be1be22d0" typeRef="feel:string"/>
  - <informationRequirement>
        <requiredDecision href="#_3bf4154e-3c80-450e-9109-080c6dc89158"/>
    </informationRequirement>
  - <informationRequirement>
        <requiredDecision href="#_736ff145-c20c-4a3c-b02d-f9d4b41de309"/>
    </informationRequirement>
  - <literalExpression id="_4b0053db-9e25-4820-9fcf-8c22b79da4de">
        <text>Greeting + ", " + Salutation + "Customer.Last Name" + "!"</text>
    </literalExpression>
```

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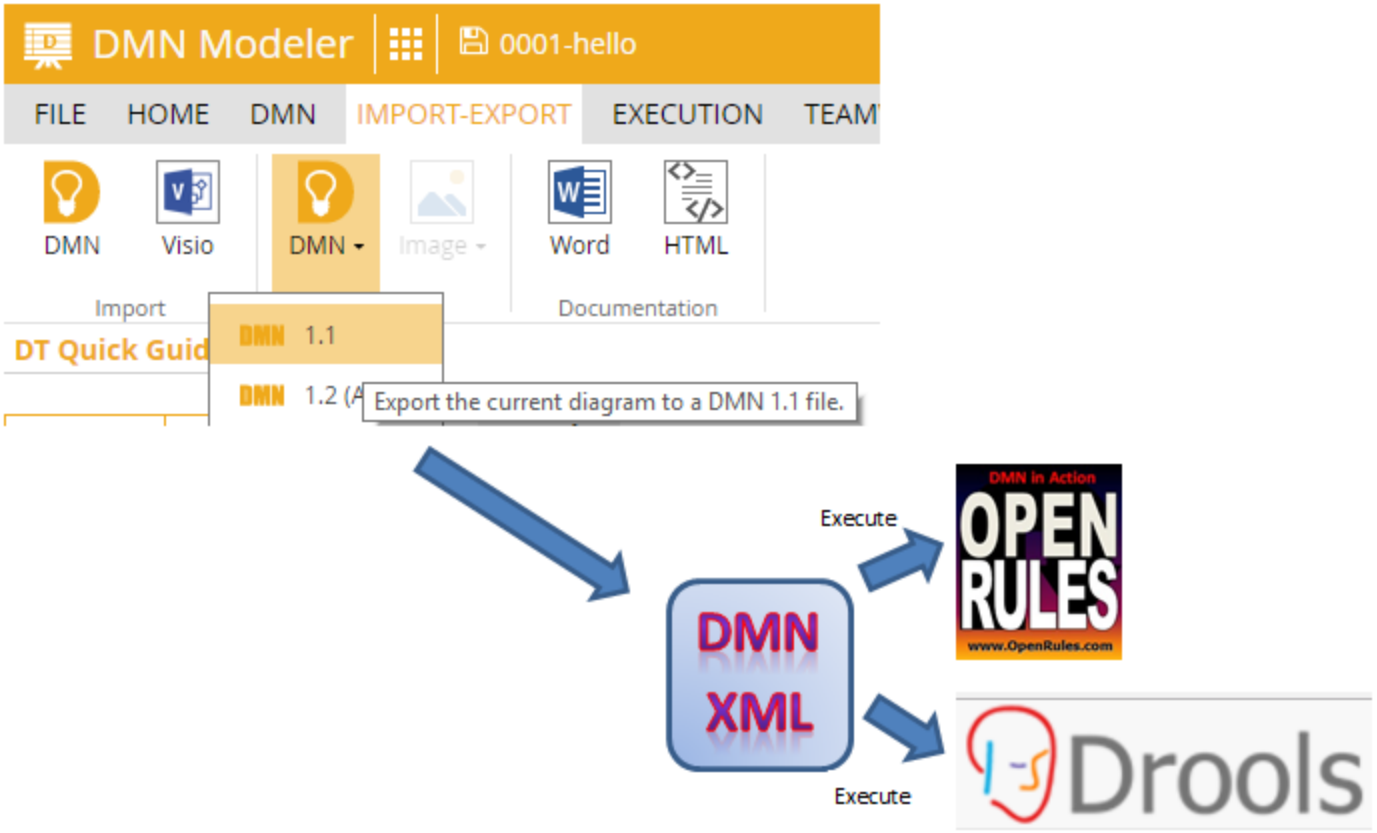
DML XML Interchange



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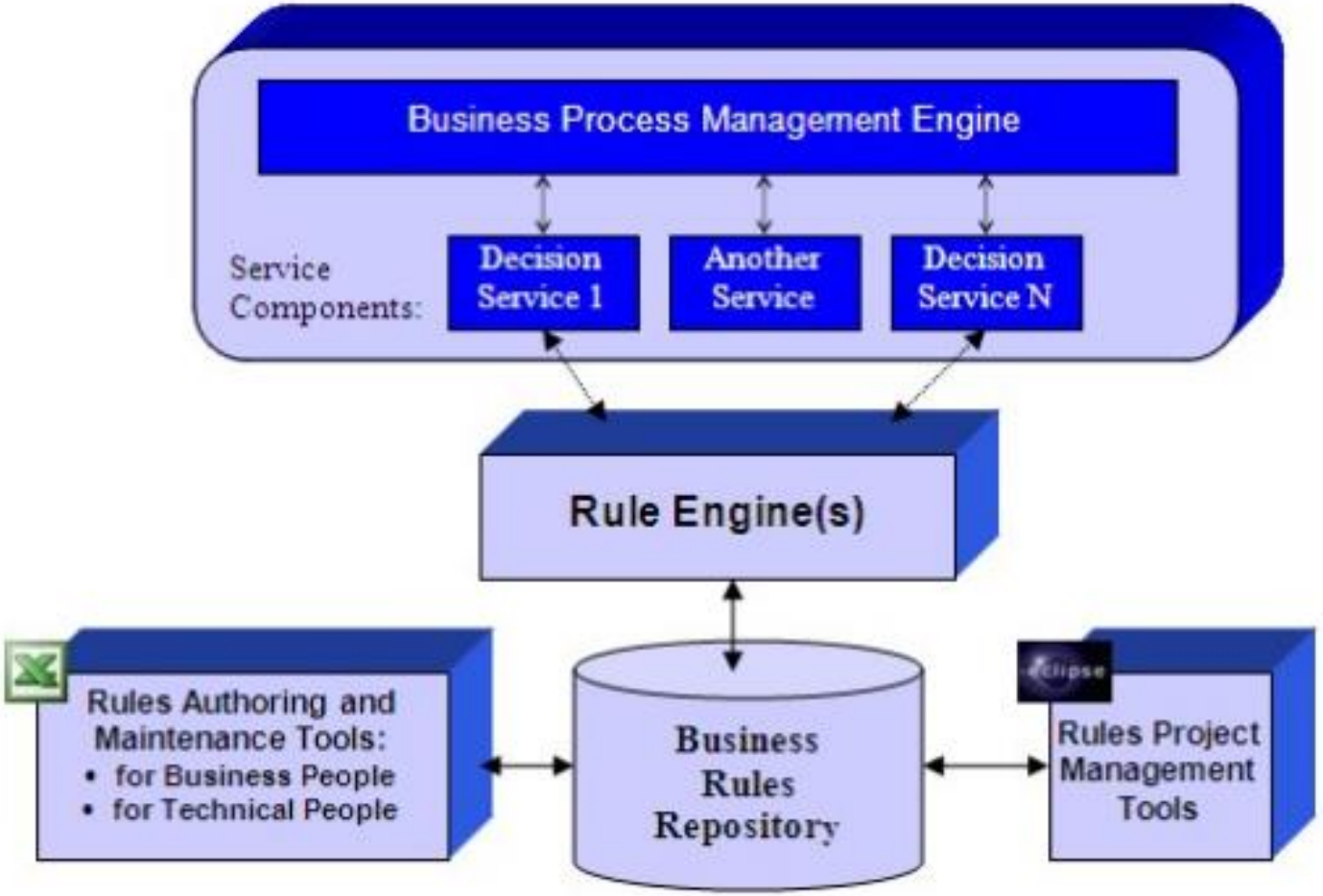
SOA Architecture with Loosely Coupled Decision Services



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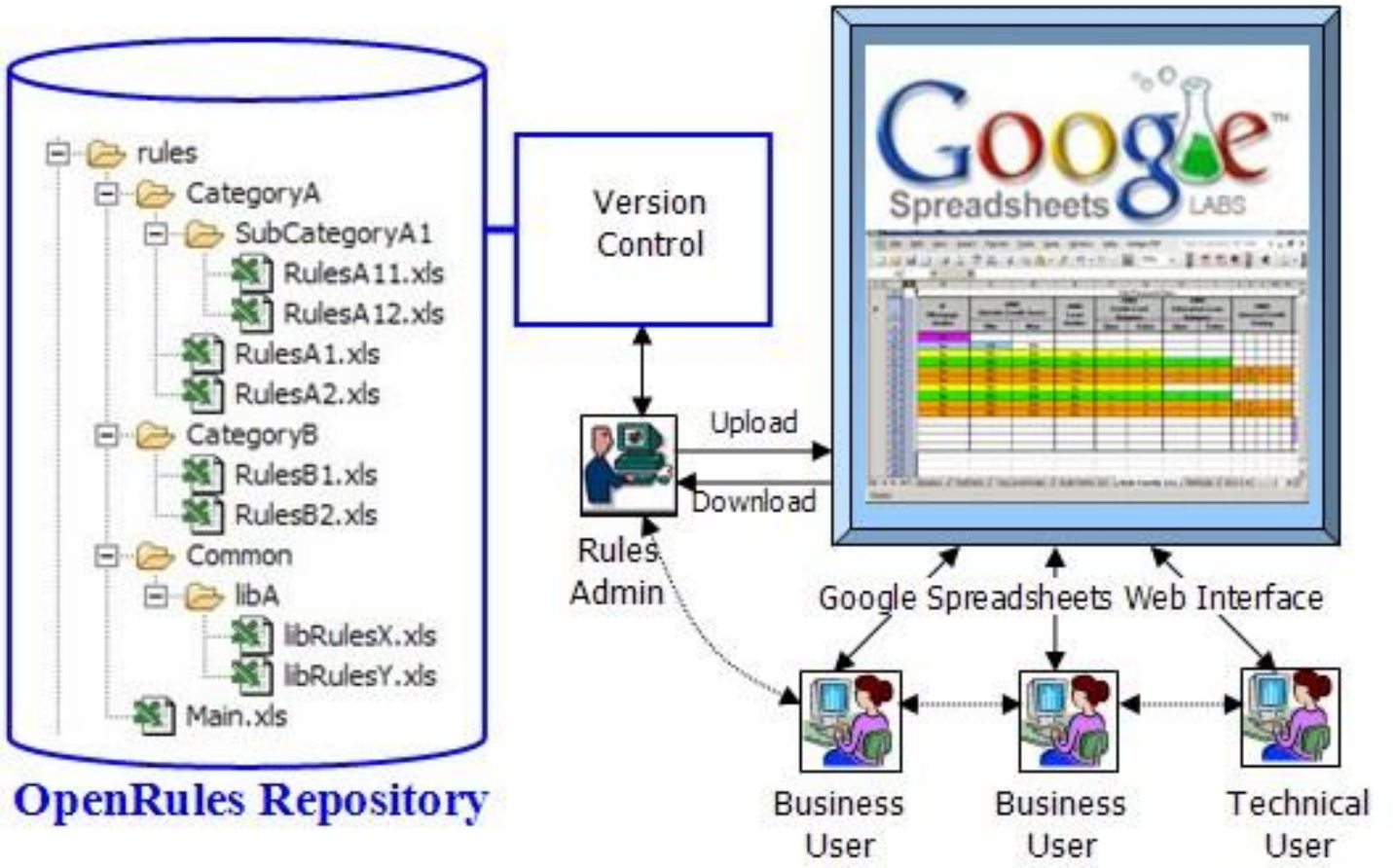
Collaraborative Rules Management with Google Docs



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More Decision Tables (Banking Example)

DecisionTable DefineCustomerProfile			
Condition		Conclusion	
Combined Balance		Customer Profile	
Within	[0..500)	Is	New
Within	[500..2000)	Is	Bronze
Within	[2000..5000)	Is	Silver
Within	[5000..15000)	Is	Gold
Within	>= 15000	Is	Platinum

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More Complex Decision Tables

DecisionTable DefineUpSellProducts							
Condition		Condition		Condition		Conclusion	
Customer Profile		**Customer Products**		**Customer Products**		**Offered Products**	
Is One Of	New,Bronze,Silver	Include	Checking Account	Do Not Include	Saving Account	Are	Saving Account, Debit/ATM Card, Web Banking
Is One Of	New,Bronze,Silver	Include	Checking Account, Overdraft Protection	Do Not Include	CD with 25 basis point increase, Money Market Mutual Fund, Credit Card	Are	CD with 25 basis point increase, Money Market Mutual Fund, Credit Card
Is One Of	New,Bronze,Silver	Include	Checking Account, Saving Account	Do Not Include	CD with 25 basis point increase, Money Market Mutual Fund, Credit Card	Are	CD with 50 basis point increase, Money Market Mutual Fund, Credit Card, Debit/ATM Card, Web Banking
Is One Of	Gold	Include	Checking Account	Do Not Include	CD with 25 basis point increase, Money Market Mutual Fund, Web Banking	Are	CD with 50 basis point increase, Money Market Mutual Fund, Credit Card, Debit/ATM Card, Web Banking, Brokerage Account
Is One Of	Platinum	Include	Checking Account, Saving Account	Do Not Include	CD with 25 basis point increase, Money Market Mutual Fund, Web Banking	Are	CD with 50 basis point increase, Money Market Mutual Fund, Credit Card with no annual fee, Debit/ATM Card, Web Banking with no charge, Brokerage Account

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1040EZ Decision Table

- Decision Table with Calculations

DecisionTable CalculateDependentAmount												
Condition		Condition		Condition		Action	Action	Action	Action	Action	Action	Action
ClaimedAsDependent		MarriedFilingJointly		SpouseClaimedAsDependent		LineA	LineB	LineC	LineD	LineE	LineF	Dependent Amount
Is	FALSE	Is	FALSE									7800
Is	FALSE	Is	TRUE									15600
Is	TRUE	Is	FALSE			Wages + 500	750	max(LineA,LineB)	4750	min(LineC,LineD)	0	LineE + LineF
Is	TRUE	Is	TRUE	Is	TRUE				9500		0	
Is	TRUE	Is	TRUE	Is	FALSE						3050	

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DecisionTable (single-hit) vs. DecisionTable1(multi-hit)

DecisionTable ValidateDrivingEligibility					
Condition		Condition		Conclusion	
Driver's Age		US State		Driving Eligibility	
>=	17			Is	Eligible
Is	16	Is Not	Florida	Is	Not Eligible
Is	16	Is	Florida	Is	Eligible
<	16			Is	Not Eligible

DecisionTableMultiHIt ValidateDrivingEligibility					
Condition		Condition		Conclusion	
Driver's Age		US State		Driving Eligibility	
				Is	Eligible
<	17			Is	Not Eligible
>=	16	Is	Florida	Is	Eligible

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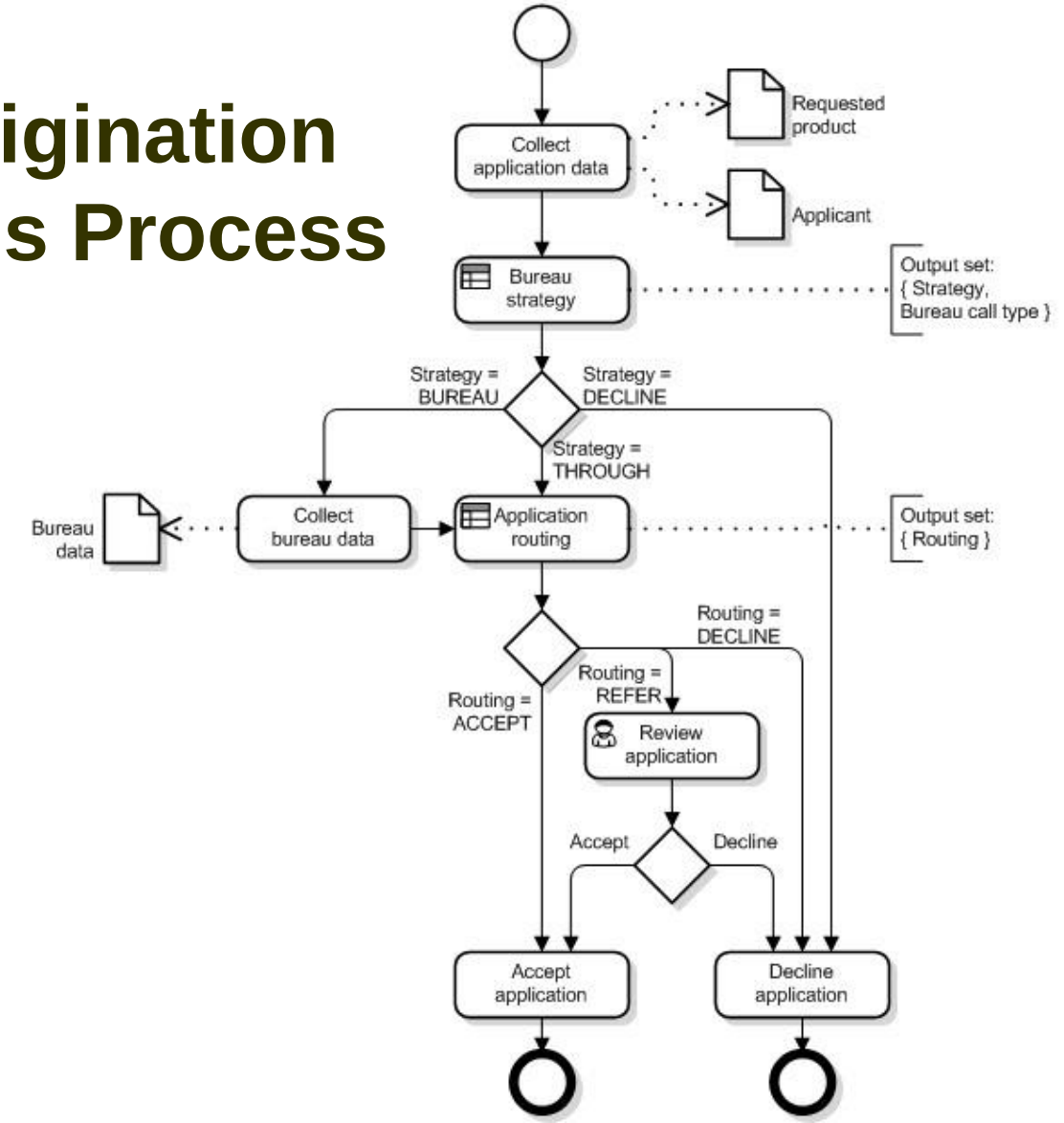
DMN Section 11 Example

- **Loan Origination Business Process**



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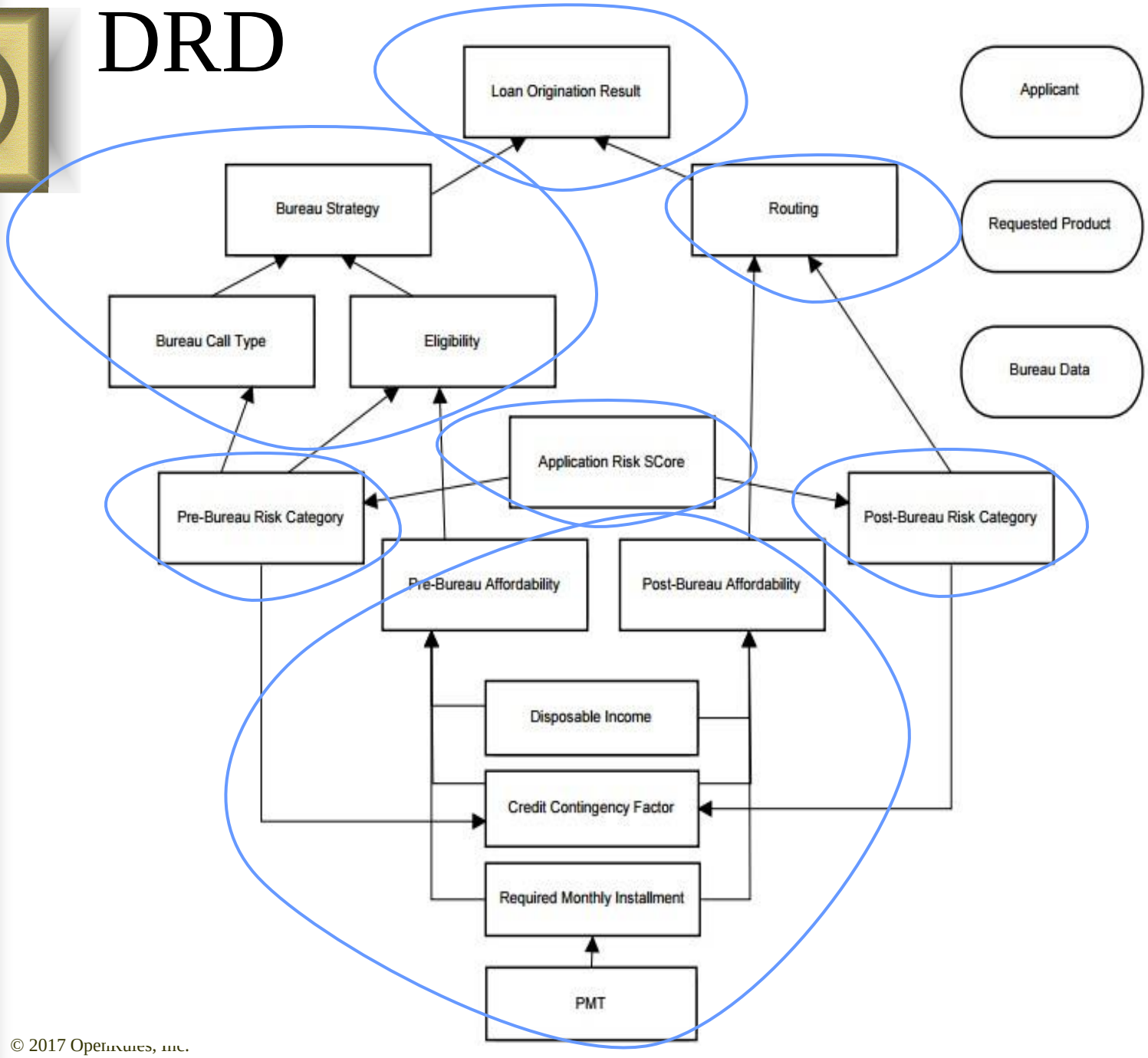
DRD



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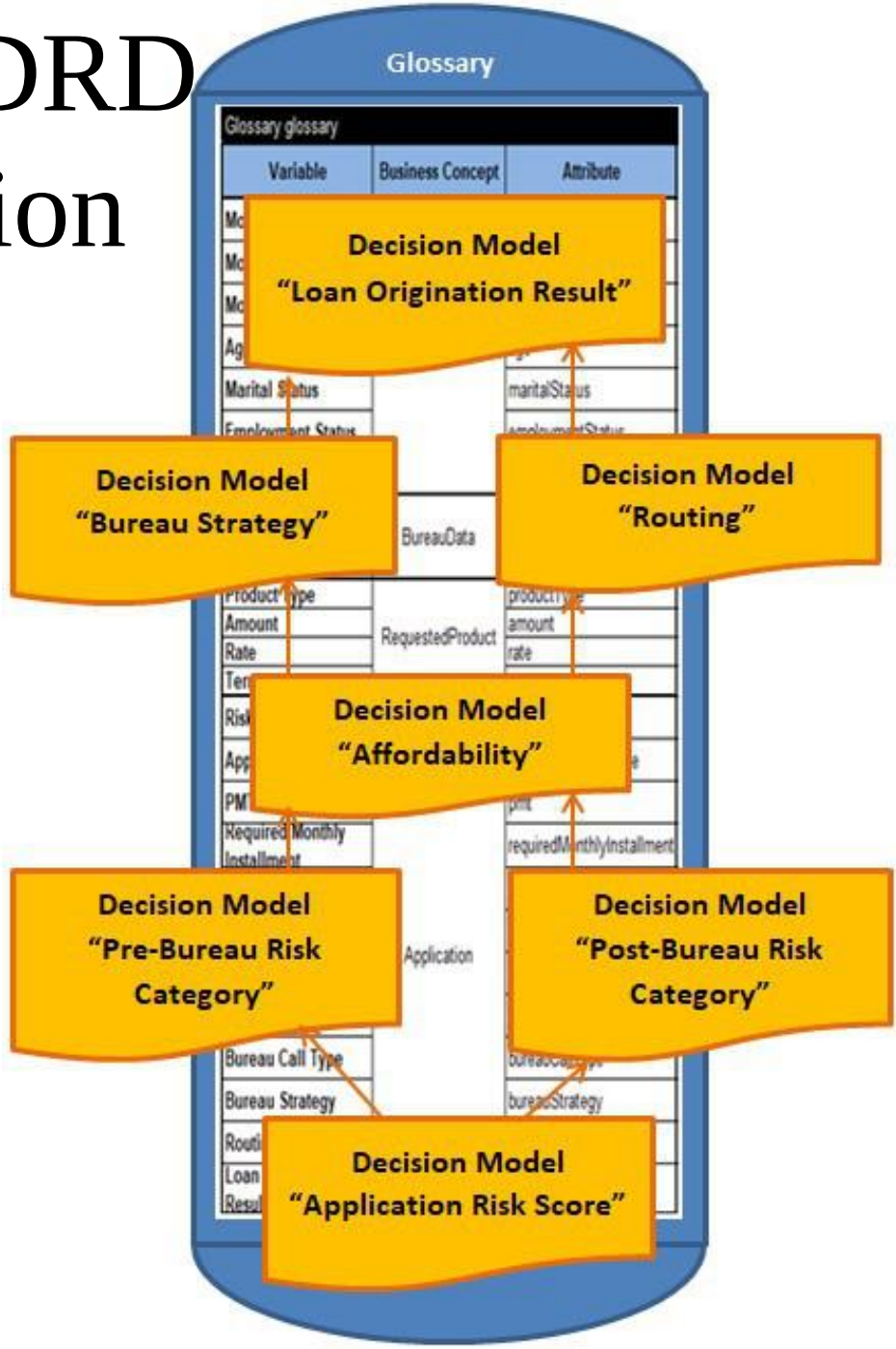
Top-Down DRD Decomposition

- We will decompose our decision model into 7 loosely coupled decision models



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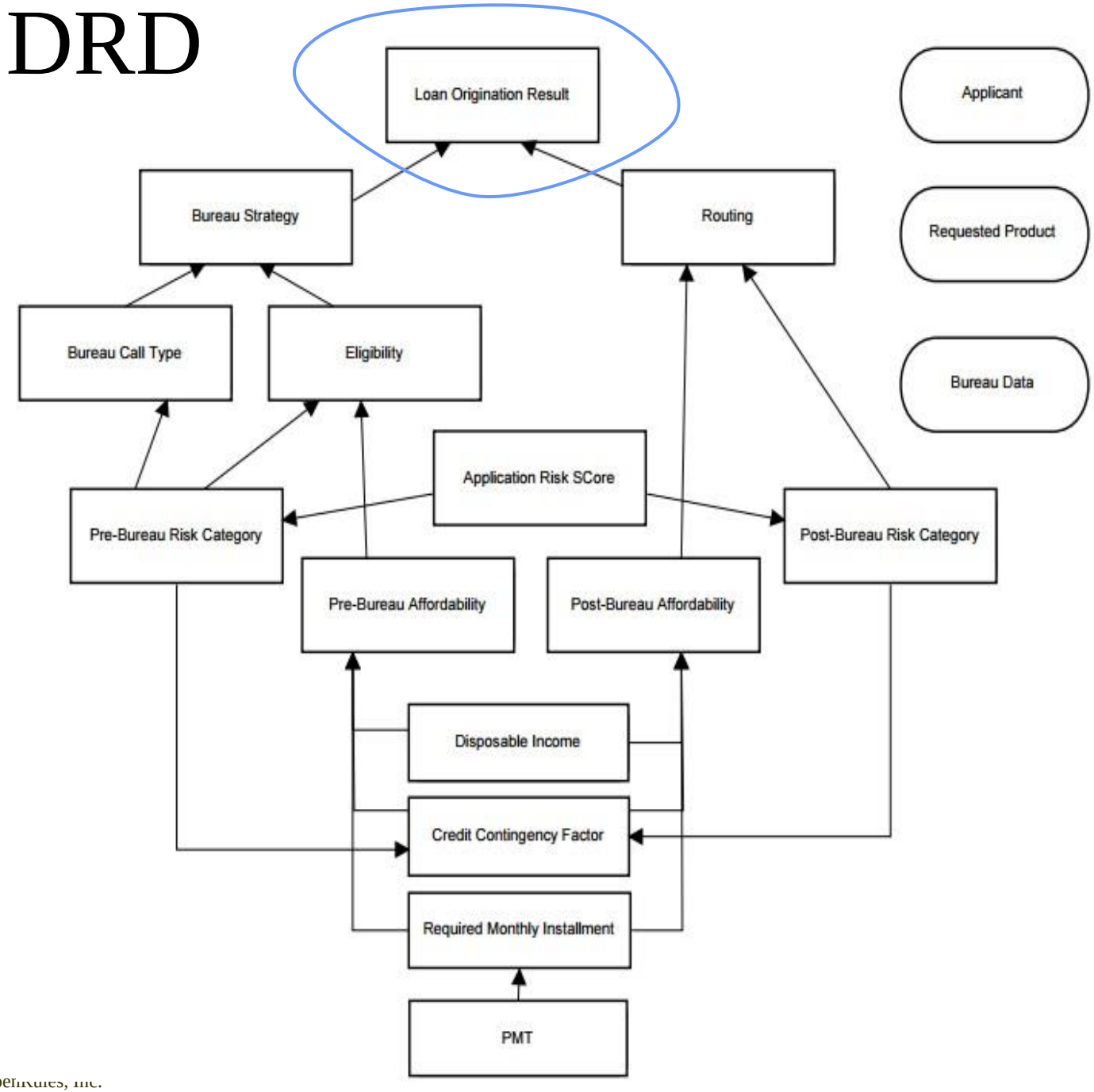
DRD



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Decision Model "Loan Origination Result"

- Decision Logic

DecisionTable LoanOriginationResult				
Condition		Condition		Action
Bureau Strategy		**Routing**		**Loan Origination Result**
Is	DECLINE			DECLINE
Is One Of	BUREAU,THROUGH	Is	DECLINE	DECLINE
Is One Of		Is	REFER	REFER
Is One Of		Is	ACCEPT	ACCEPT

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Decision Model "Loan Origination Result"

Glossary glossary		
Variable	**Business Concept**	**Attribute**
Bureau Strategy	Application	bureauStrategy
Routing		routing
Loan Origination Result		loanOriginationResult

Decision DetermineLoanOriginationResult	
Display	**Execute**
Loan Origination Result	LoanOriginationResult

Datatype Application	
String	bureauStrategy
String	routing
String	loanOriginationResult

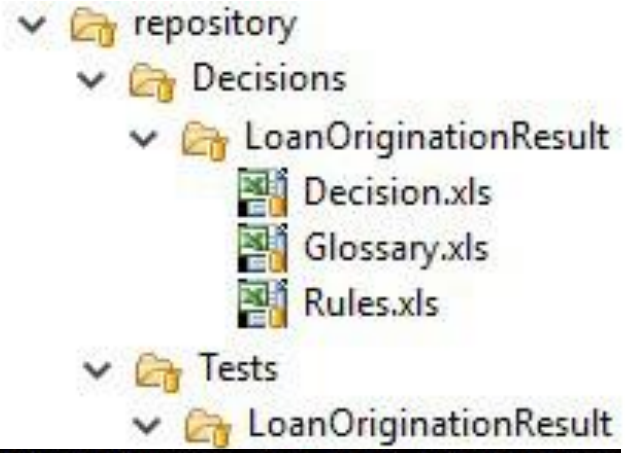
Data Application applications		
bureauStrategy	routing	loanOriginationResult
Bureau Strategy	**Routing**	**Loan Origination Result**
DECLINE	?	?
BUREAU	DECLINE	?
THROUGH	REFER	?

DecisionTableTest testCases		
#	ActionUseObject	ActionExpect
Test ID	**Application**	**Loan Origination Result**
Test 1	:= applications[0]	DECLINE
Test 2	:= applications[1]	DECLINE
Test 3	:= applications[2]	REFER

- Test Data

Decision Model "Loan Origination Result"

- Organization Structure



- Execution Results

```
Decision LoanOriginationResult has been initialized

RUN TEST: Test 1
Assign: Loan Origination Result = DECLINE [DECLINE]
Validating results for the test <Test 1>
Test 1 was successful

RUN TEST: Test 2
Assign: Loan Origination Result = DECLINE [DECLINE]
Validating results for the test <Test 2>
Test 2 was successful

RUN TEST: Test 3
Assign: Loan Origination Result = REFER [REFER]
Validating results for the test <Test 3>
Test 3 was successful
All 3 tests succeeded!
```

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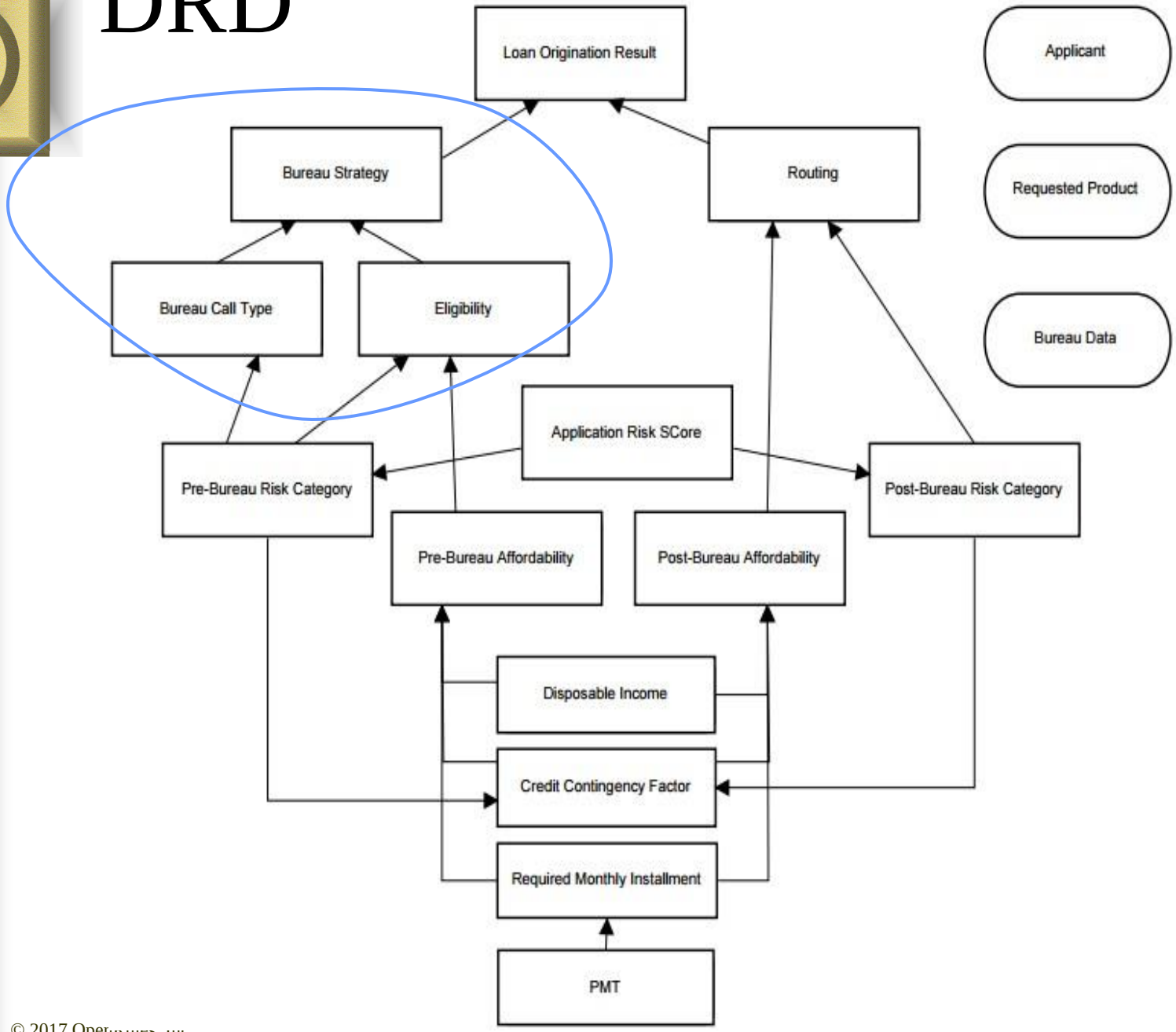
DRD



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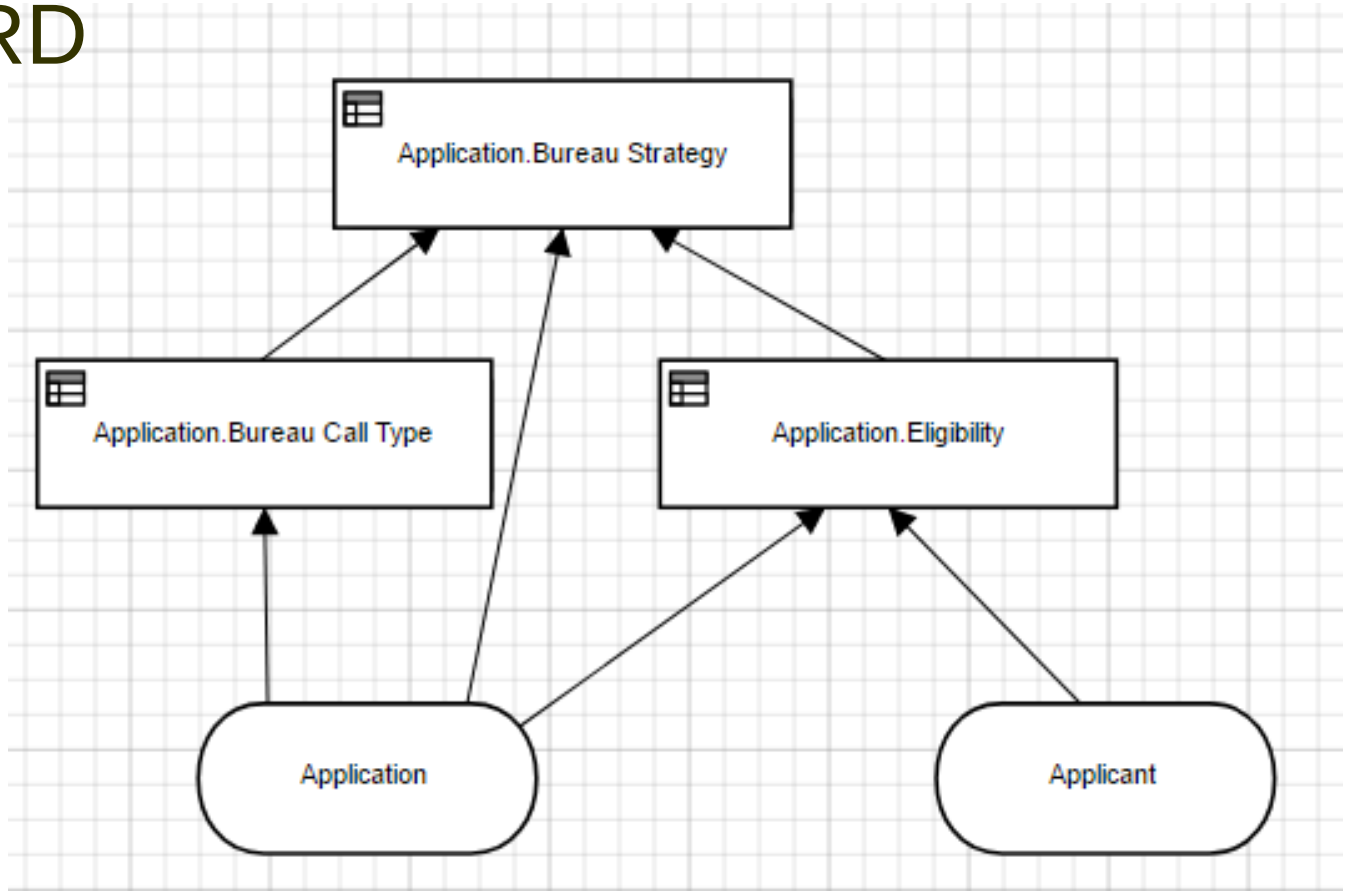
Decision Model "Bureau Strategy"

- DRD



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Decision Model "Bureau Strategy"

- Decision Logic

DecisionTable BureauStrategy

Condition		Condition		Action
Eligibility		**Bureau Call Type**		**Bureau Strategy**
Is	INELIGIBLE			DECLINE
Is	ELIGIBLE	Is One Of	FULL, MINI	BUREAU
Is		Is	NONE	THROUGH

DecisionTable BureauCallType

Condition		Action
Risk Category		**Bureau Call Type**
Is One Of	HIGH,MEDIUM	FULL
Is	LOW	MINI
Is One Of	VERY LOW, DECLINE	NONE

DecisionTable BureauCallType

Condition		Action
Risk Category		**Bureau Call Type**
Is One Of	HIGH,MEDIUM	FULL
Is	LOW	MINI
Is One Of	VERY LOW, DECLINE	NONE

Glossary glossary

Variable	Business Concept	Attribute
Age	Applicant	age
Risk Category	Application	riskCategory
Affordability		affordability
Eligibility		eligibility
Bureau Call Type		bureauCallType
Bureau Strategy		bureauStrategy

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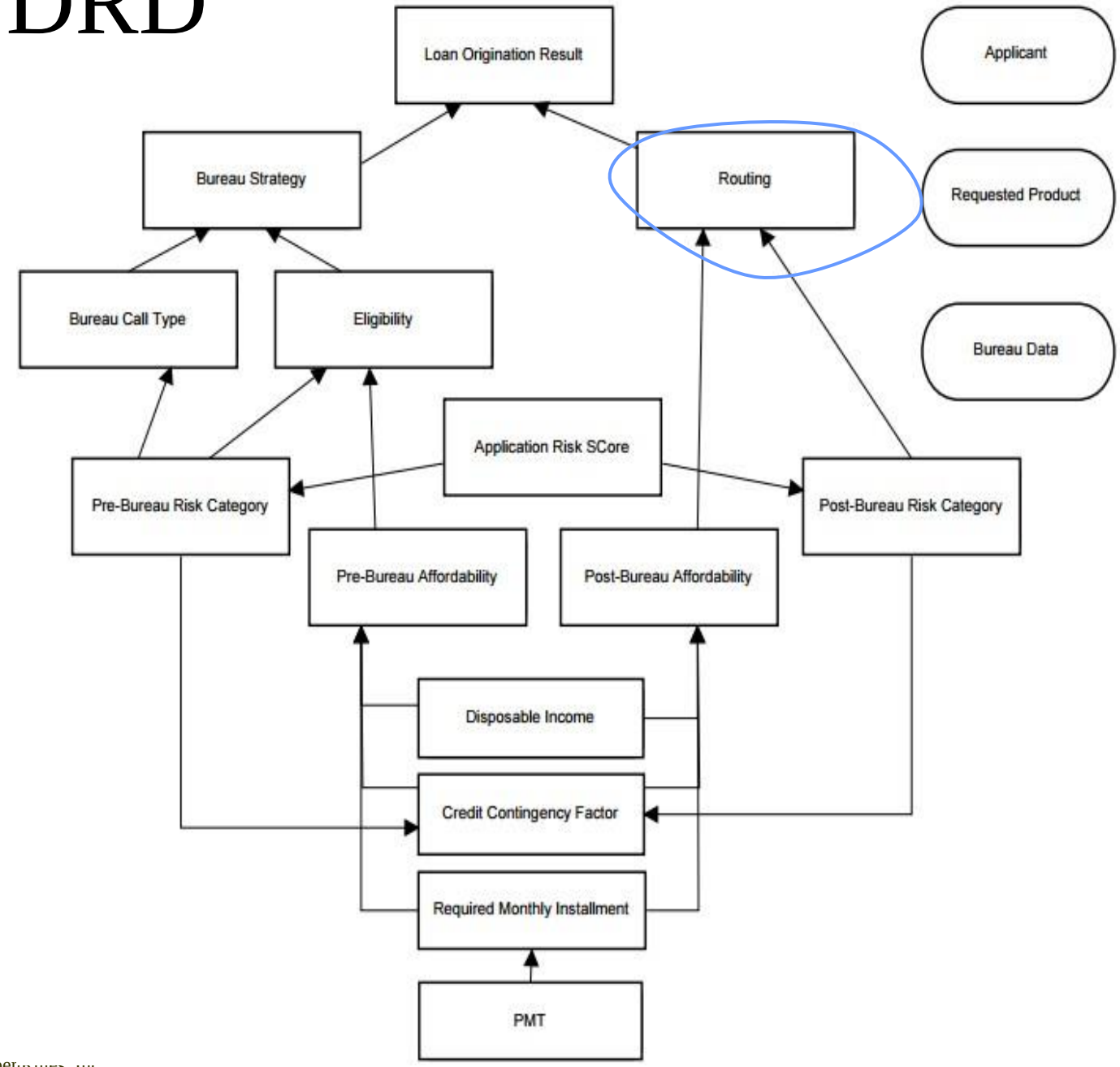
DRD



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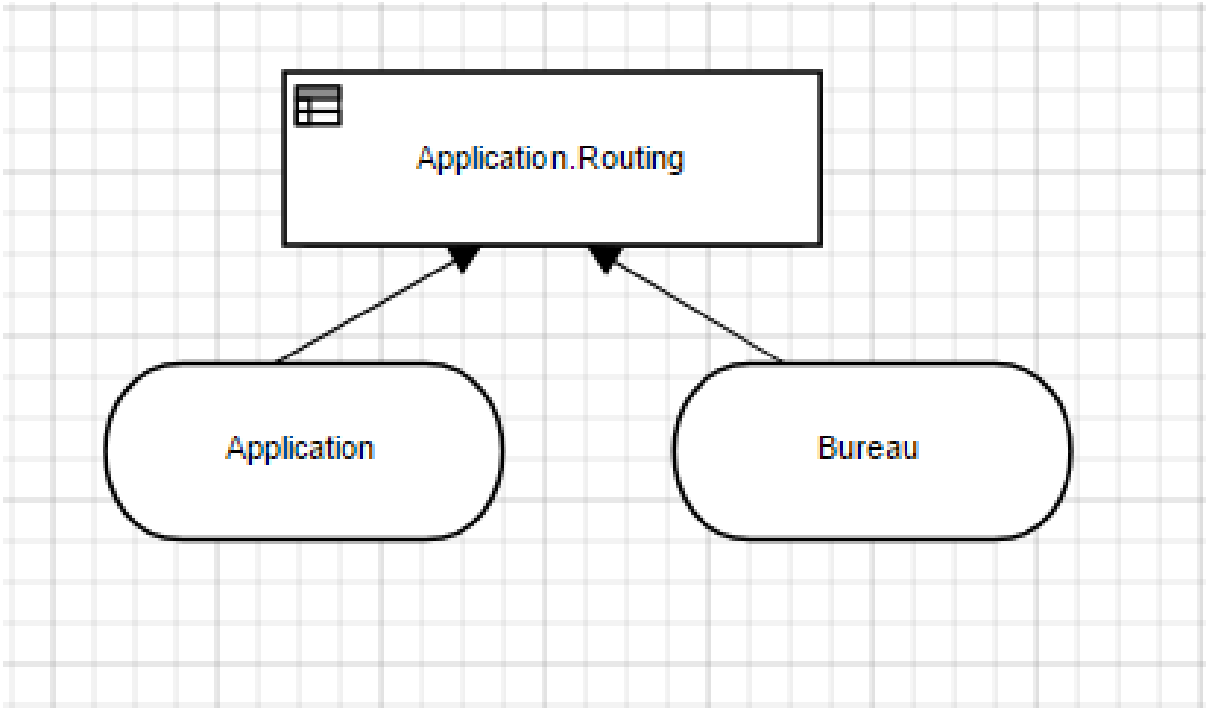
Decision Model “Routing”

- DRD



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Decision Model "Routing"

- Decision Logic

DecisionTable Routing				
If	If	If	If	Then
Affordability	**Bankrupt**	**Risk Category**	**Credit Score**	**Routing**
FALSE				DECLINE
TRUE	TRUE			DECLINE
TRUE	FALSE	DECLINE		DECLINE
TRUE		HIGH		REFER
TRUE			<580	REFER
TRUE			>=580	ACCEPT

Data Application applications		
riskCategory	affordability	routing
Risk Category	**Affordability**	**Routing**
VERY LOW	FALSE	?
LOW	FALSE	?
LOW	FALSE	?

Datatype Application	
String	riskCategory
boolean	affordability
String	routing

Bureau

Data BureauData bureauData		
bureau	bankrupt	creditScore
Bureau	**Bankrupt**	**Credit Score**
Bureau 1	FALSE	600
Bureau 2	FALSE	630
Bureau 3	FALSE	720

Datatype BureauData	
String	bureau
boolean	bankrupt
int	creditScore

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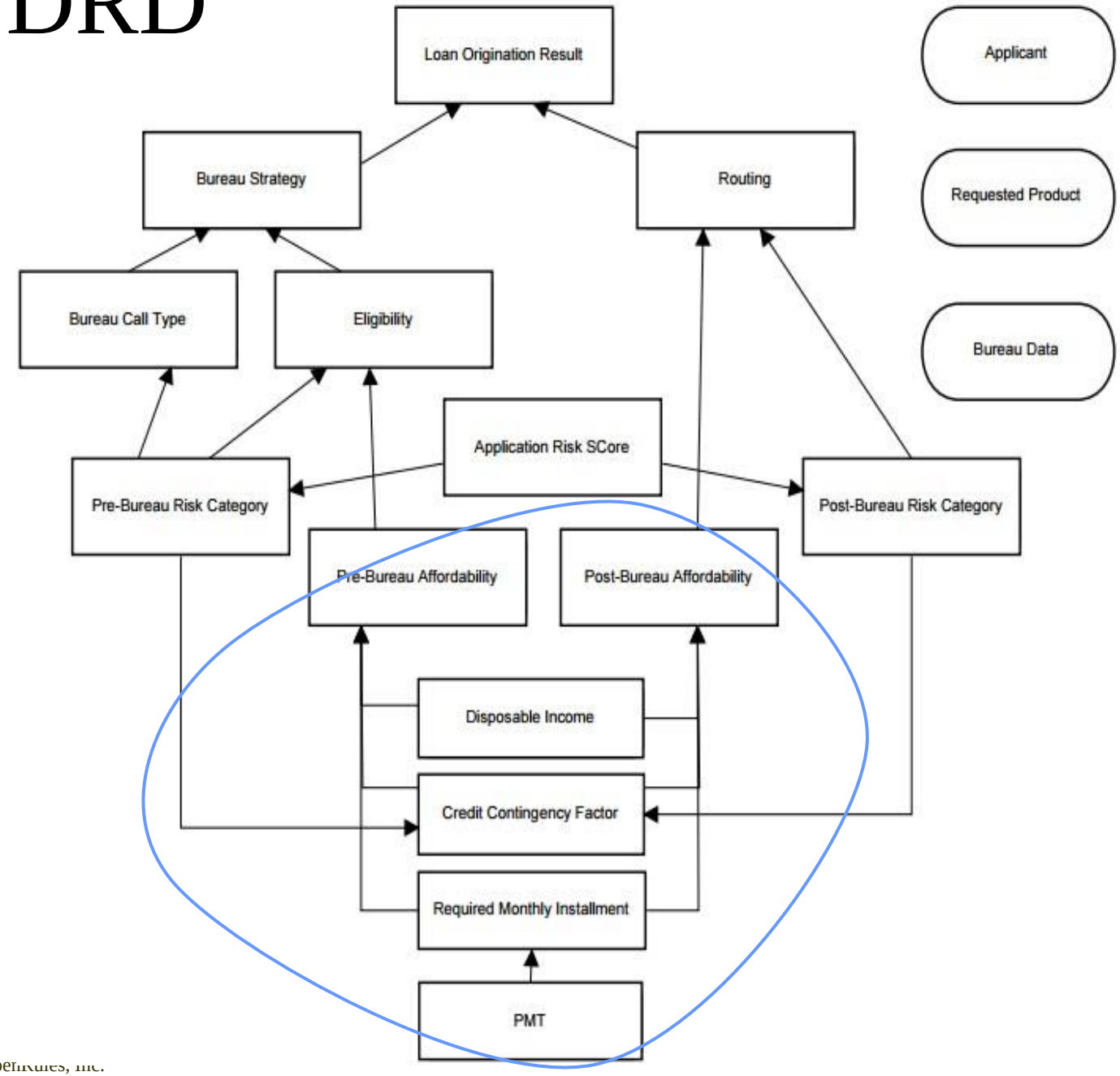
DRD



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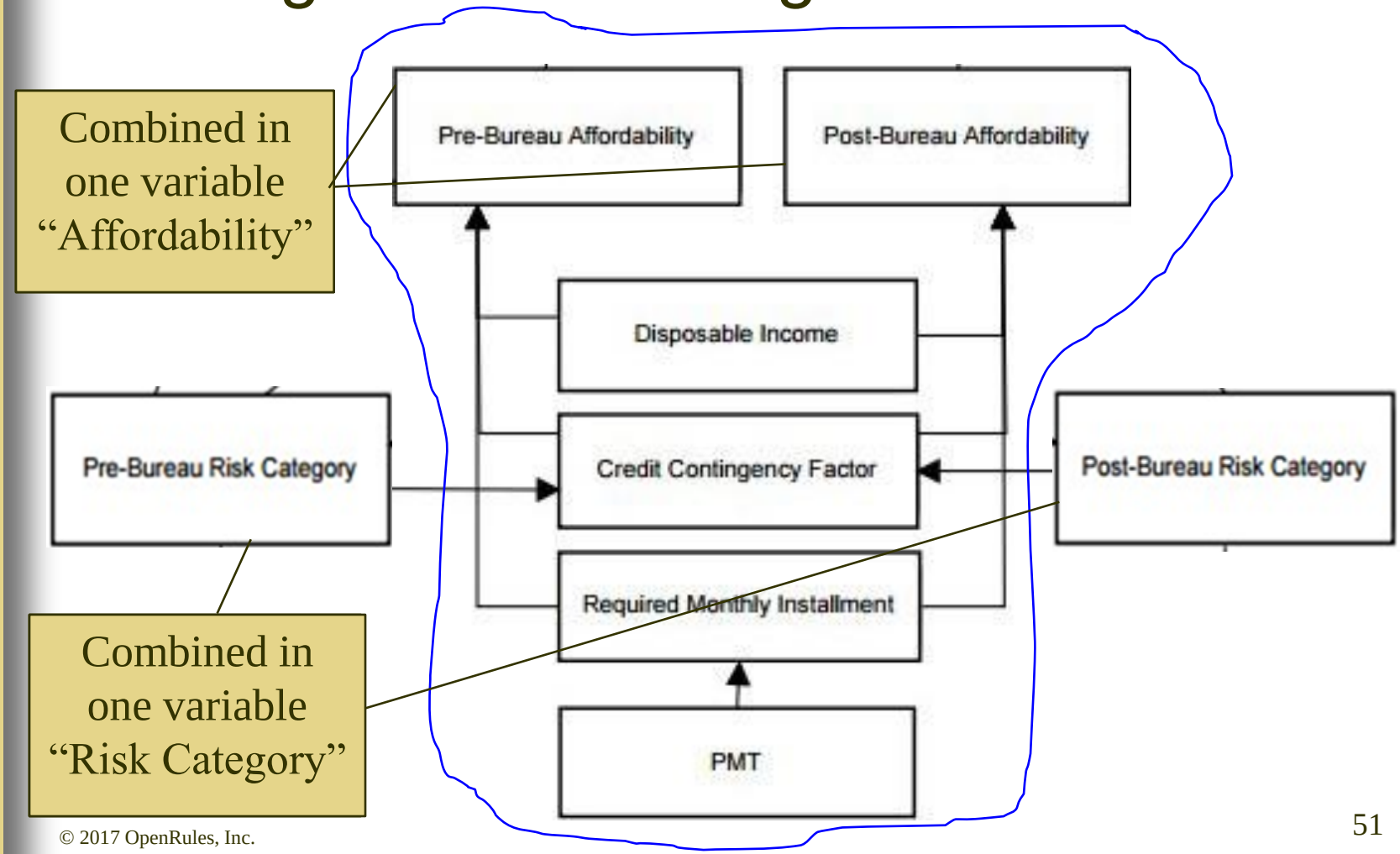
Decision Model "Affordability"

- A fragment of the "big" DRD



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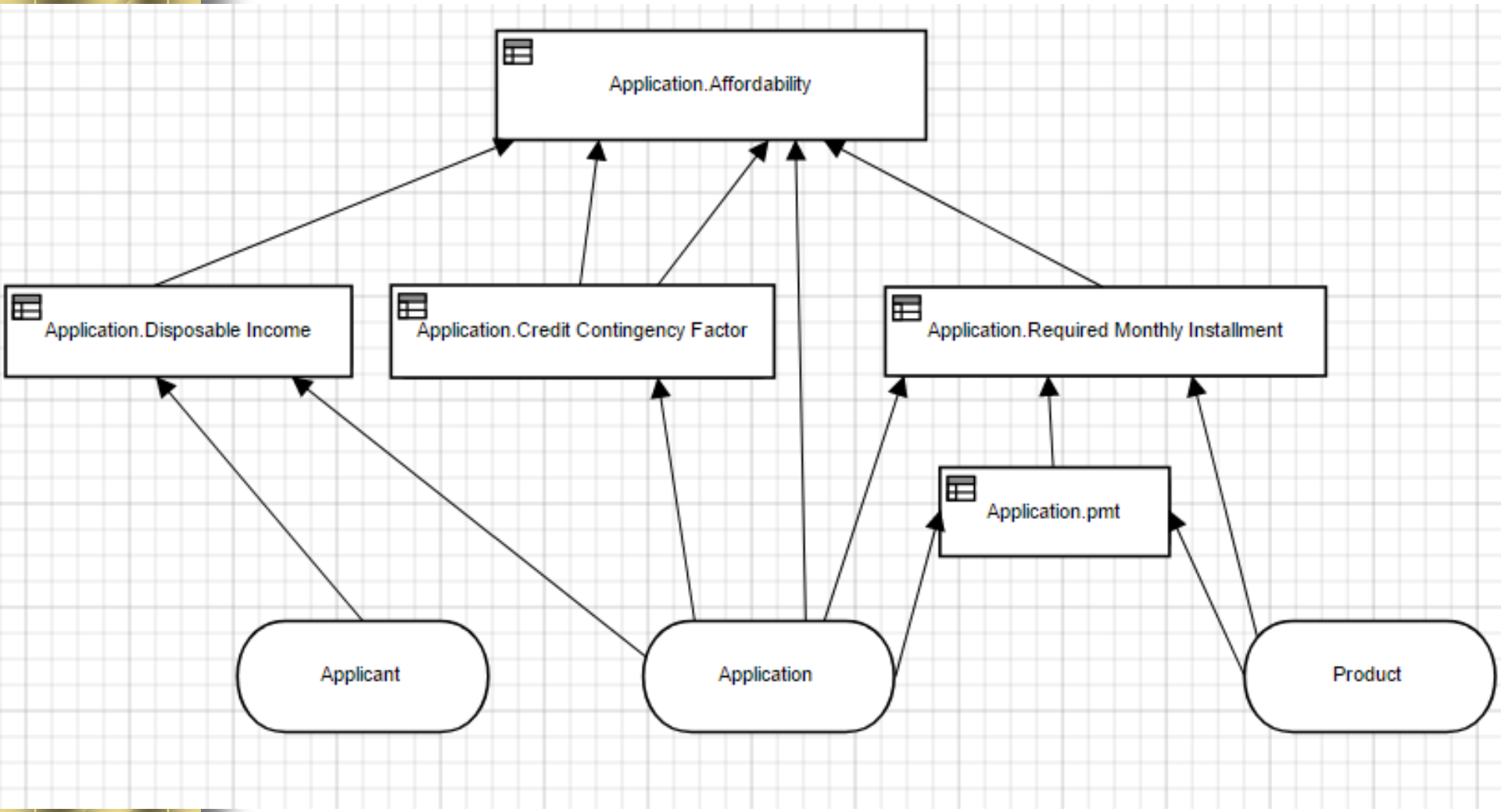
Decision Model "Affordability" - DRD



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Decision Model "Affordability" – Decision Logic

DecisionTable Affordability	
If	Then
Required Monthly Installment	**Affordability**
< Disposable Income * Credit Contingency Factor	TRUE
	FALSE

DecisionTable DisposableIncome
Action
Disposable Income
Monthly Income - (Monthly Repayments + Monthly Expenses)

DecisionTable CreditContingencyFactor		
Condition		Action
Risk Category		**Credit Contingency Factor**
Is One Of	HIGH,DECLINE	0.6
Is	MEDIUM	0.7
Is One Of	LOW, VERY LOW	0.8

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Decision Model "Affordability"

- Calculation Logic with a FEEL formula

DecisionTable RequiredMonthlyInstallment		
Condition		Action
Product Type		**Required Monthly Installment**
Is	SPECIAL LOAN	PMT + 25.00
		PMT + 20.00

DecisionTable PMT
Action
PMT
(Amount * Rate/12) / (1 - (1 +Rate/12) ** -Term)

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Decision Model "Affordability"

- Combining sub-decisions

Decision AffordabilitySubDecisions	
Display	**Execute**
Determine Credit Contingency Factor	CreditContingencyFactor
Calculate PMT	PMT
Determine Required Monthly Installment	RequiredMonthlyInstallment
Determine Disposable Income	DisposableIncome
Determine Affordability	Affordability

- External decision name

Decision DetermineAffordability	
Display	**Execute**
AffordabilitySubDecisions	AffordabilitySubDecisions

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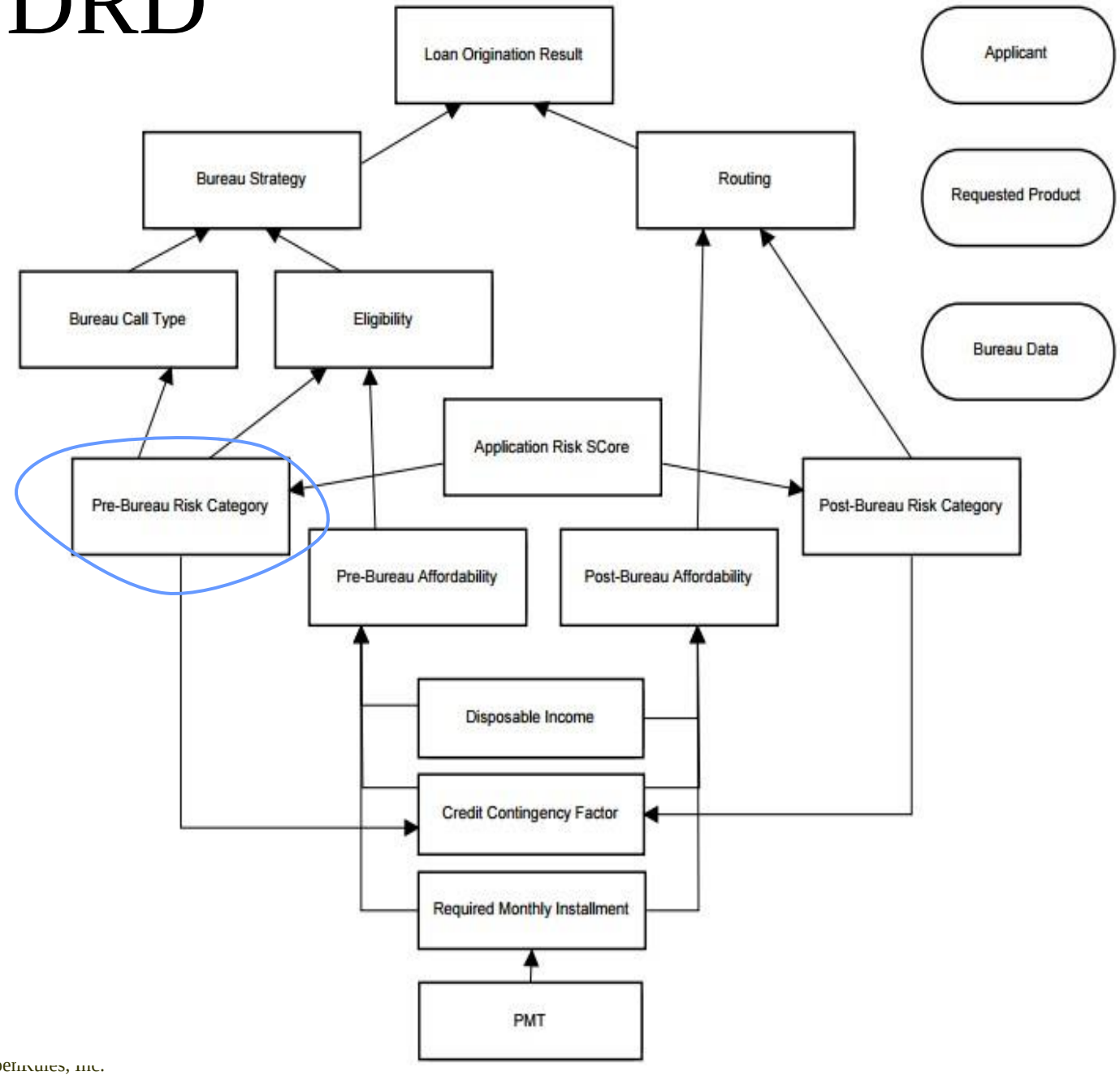
DRD



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Decision Model "**Pre**-Bureau Risk Category"

- Defines the variable "Risk Category"

DecisionTable PreBureauRiskCategory			
Condition		If	Then
Existing Customer		**Application Risk Score**	**Risk Category**
Is	TRUE	<100	HIGH
Is		[100..120)	MEDIUM
Is		[120..130]	LOW
Is		>130	VERY LOW
Is	FALSE	<80	DECLINE
Is		[80..90)	HIGH
Is		[90..110]	MEDIUM
Is		>110	LOW

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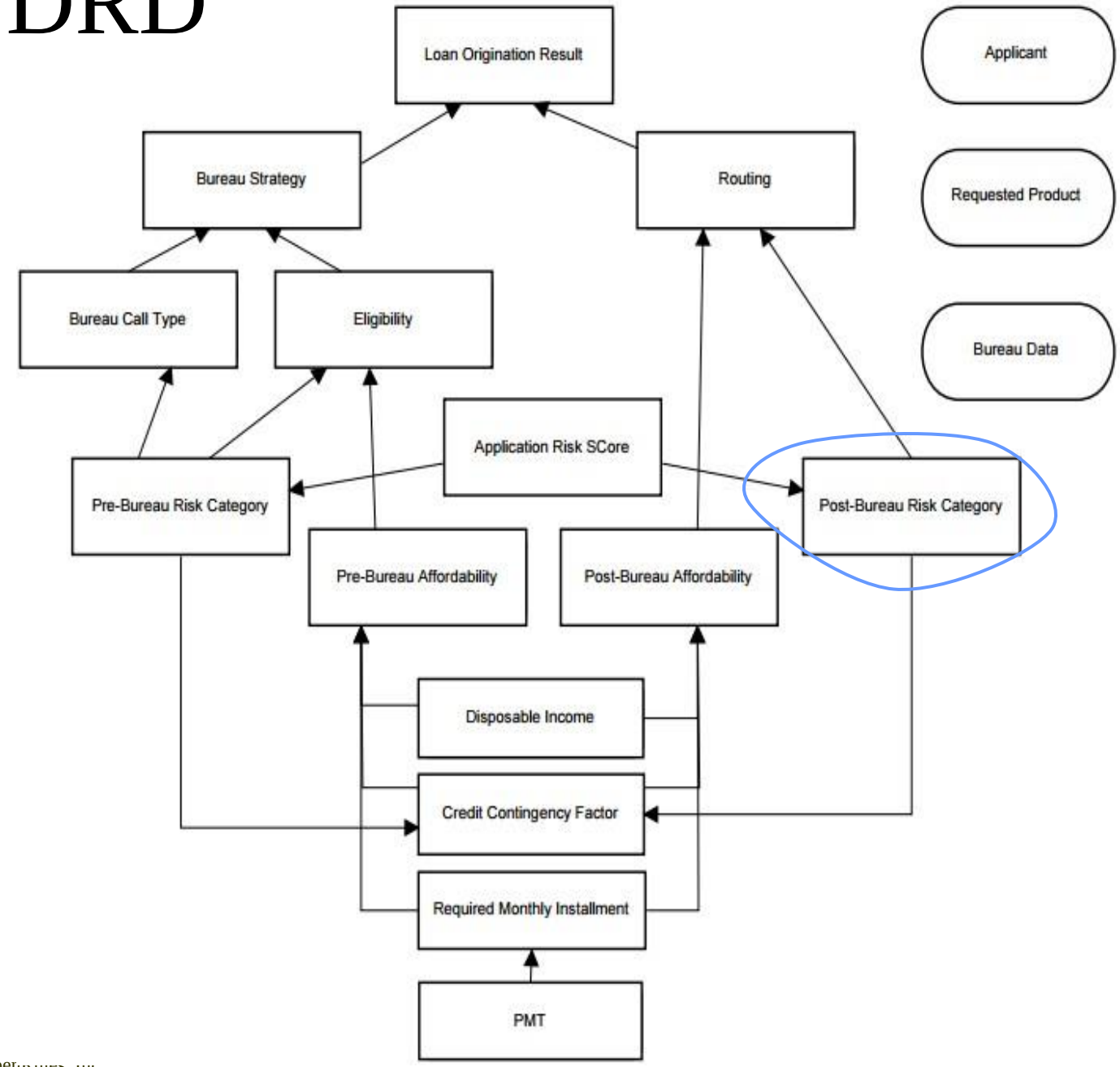
DRD



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Decision Model "**Post**-Bureau Risk Category"

- Defines the variable "Risk Category"

DecisionTable PostBureauRiskCategory				
Condition		If	If	Then
Existing Customer		Application Risk Score	Credit Score	Risk Category
Is	TRUE	< 120	<590	HIGH
Is			[590..610]	MEDIUM
Is			>610	LOW
Is		[120..130]	<600	HIGH
Is			[600..625]	MEDIUM
Is			>625	LOW
Is		> 130		VERY LOW
Is	FALSE	<=100	<580	HIGH
Is			[580..600]	MEDIUM
Is			>600	LOW
Is		>100	<590	HIGH
Is			[590..615]	MEDIUM
Is			>615	LOW

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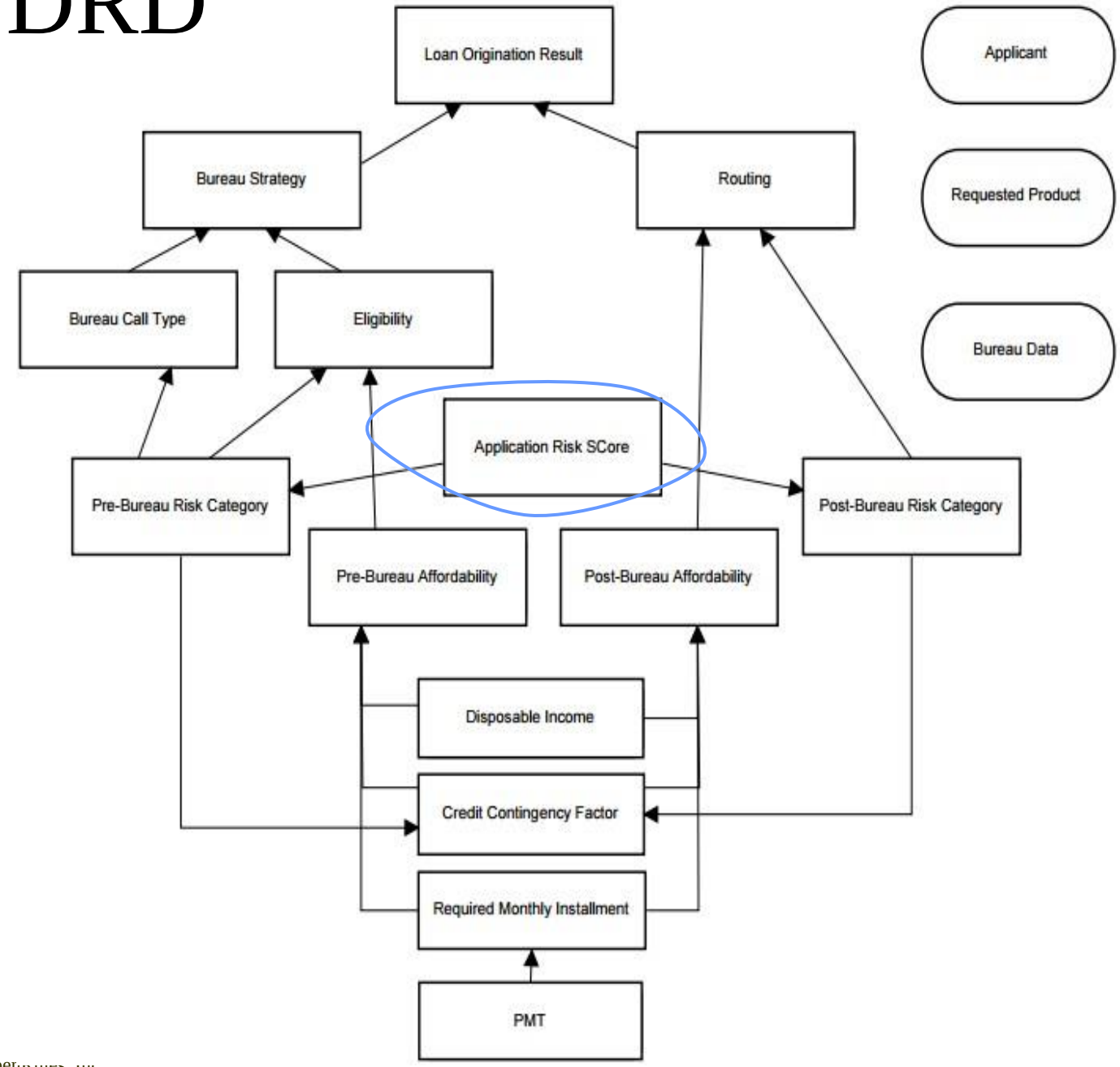
DRD



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Decision Model "Application Risk Score"

- A typical "scorecard"

DecisionTableMultiHit ApplicationRiskScore				
If	If	If	Conclusion	
Age	Marital Status	Employment Status	Application Risk Score	
			=	0
[18..21]			+=	32
[22..25]			+=	35
[26..35]			+=	40
[36..49]			+=	43
>=50			+=	48
	S		+=	25
	M		+=	45
		UNEMPLOYED	+=	15
		STUDENT	+=	18
		EMPLOYED	+=	45
		SELF-EMPLOYED	+=	36

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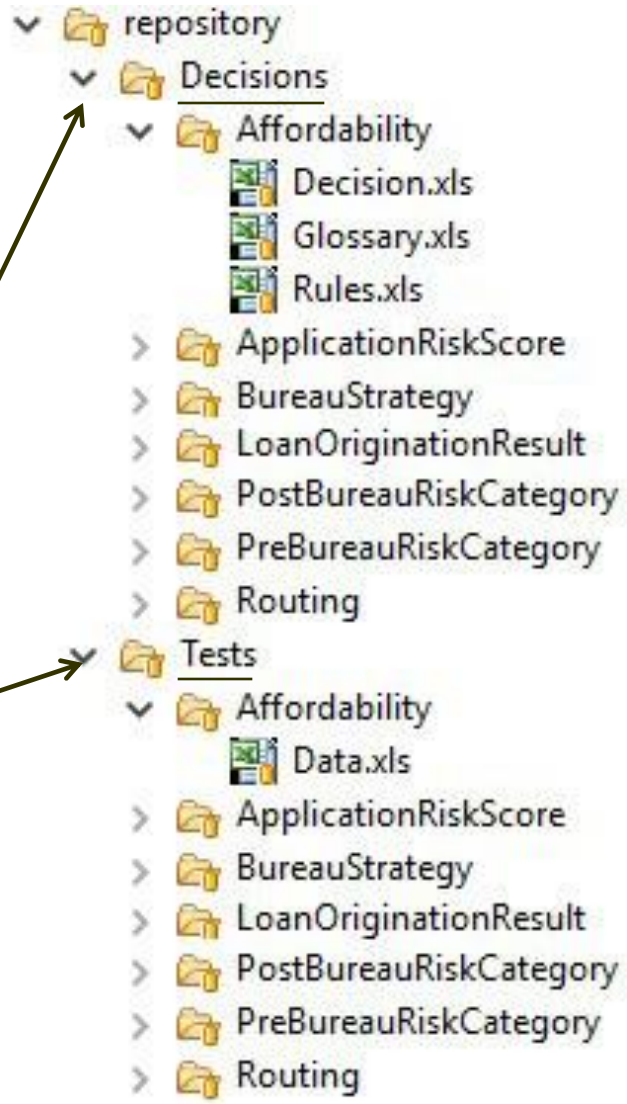
Linking Loosely Coupled Decision Models Together

Our repository now contains 7 tested loosely coupled decision models and

their test-cases



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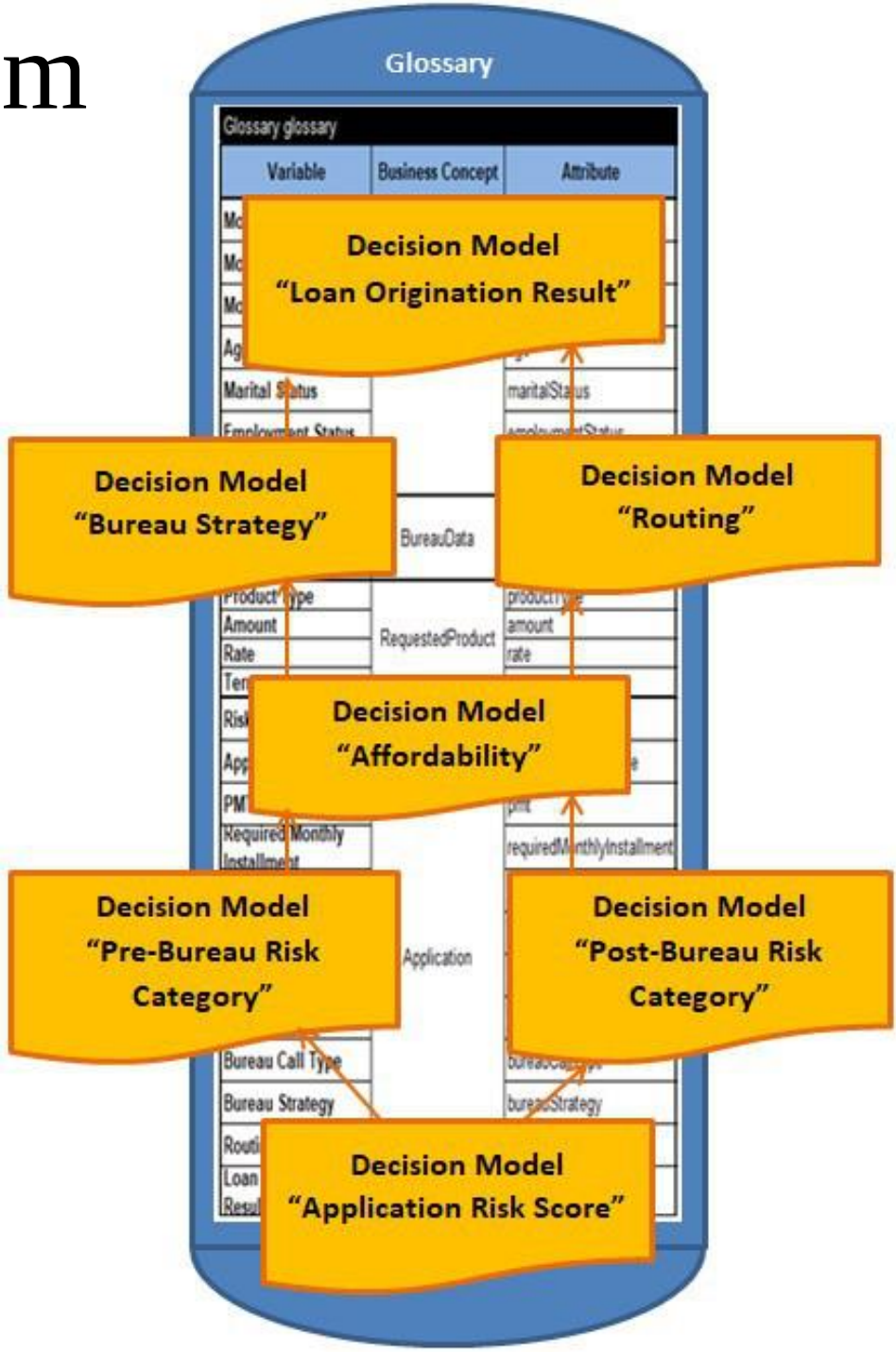
Keeping them together

- A “big” glossary serves as a spine that keeps all surrounding decision models together:



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Combined Glossary

Glossary glossary		
Variable	**Business Concept**	**Attribute**
Monthly Income	Applicant	monthlyIncome
Monthly Repayments		monthlyRepayments
Monthly Expenses		monthlyExpenses
Age		age
Marital Status		maritalStatus
Employment Status		employmentStatus
Existing Customer		existingCustomer
Bankrupt	BureauData	bankrupt
Credit Score		creditScore
Product Type	RequestedProduct	productType
Amount		amount
Rate		rate
Term		term
Risk Category	Application	riskCategory
Application Risk Score		applicationRiskScore
PMT		pmt
Required Monthly Installment		requiredMonthlyInstallment
Disposable Income		disposableIncome
Credit Contingency Factor		creditContingencyFactor
Affordability		affordability
Eligibility		eligibility
Bureau Call Type		bureauCallType
Bureau Strategy		bureauStrategy
Routing		routing
Loan Origination Result		loanOriginationResult

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Importing Decision Models

DecisionImport decisionImports	
Imported Decision File	**Internal Decision Name**
file:repository/Decisions/ApplicationRiskScore/Decision.xls	DetermineApplicationRiskScore
file:repository/Decisions/PreBureauRiskCategory/Decision.xls	DeterminePreBureauRiskCategory
file:repository/Decisions/Affordability/Decision.xls	DetermineAffordability
file:repository/Decisions/BureauStrategy/Decision.xls	DetermineBureauStrategy
file:repository/Decisions/PostBureauRiskCategory/Decision.xls	DeterminePostBureauRiskCategory
file:repository/Decisions/Routing/Decision.xls	DetermineRouting
file:repository/Decisions/LoanOriginationResult/Decision.xls	DetermineLoanOriginationResult

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Defining Integrated Decision Models

Decision DetermineLoanOrigination			
Condition		ActionPrint	ActionExecute
Bureau Strategy		**Display**	**Execute**
		DetermineApplicationRiskScore	DetermineApplicationRiskScore
		SubDecisionBureauStrategy	SubDecisionBureauStrategy
Is Not	DECLINE	SubDecisionRouting	SubDecisionRouting
		DetermineLoanOriginationResult	DetermineLoanOriginationResult

Decision SubDecisionBureauStrategy	
Display	**Execute**
DetermineRiskCategoryPreBureau	DeterminePreBureauRiskCategory
DetermineAffordability	DetermineAffordability
DetermineBureauStrategy	DetermineBureauStrategy

Decision SubDecisionRouting	
Display	**Execute**
DetermineRiskCategoryPostBureau	DeterminePostBureauRiskCategory
DetermineAffordability	DetermineAffordability
DetermineRouting	DetermineRouting

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Defining Test Data "Applicant"

Data Applicant applicants							
fullName	monthlyIncome	monthlyRepayments	monthlyExpenses	age	maritalStatus	employmentStatus	existingCustomer
Full Name	**Monthly Income**	**Monthly Repayments**	**Monthly Expenses**	**Age**	**Marital Status**	**Employment Status**	**Existing Customer**
Peter N. Johnson	10000	2800	3000	51	M	EMPLOYED	TRUE
Peter A. Norton	10000	2800	3000	51	M	EMPLOYED	FALSE
Mary K. Brown	7300	2000	1400	24	M	STUDENT	TRUE
Robert Cooper Jr.	9400	1800	1200	59	Other	UNEMPLOYED	TRUE

Datatype Applicant	
String	fullName
double	monthlyIncome
double	monthlyRepayments
double	monthlyExpenses
int	age
String	maritalStatus
boolean	existingCustomer
String	employmentStatus

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Defining Test Data "RequestedProduct"

Data RequestedProduct products			
productType	amount	rate	term
Product Type	**Amount**	**Rate**	**Loan Term**
STANDARD LOAN	100000	0.08	36
STANDARD LOAN	100000	0.08	36
SPECIAL LOAN	150000	0.32	148
STANDARD LOAN	120000	0.54	72

Datatype RequestedProduct	
String	productType
int	amount
double	rate
int	term

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Defining Test Data "BureauData"

Data BureauData bureauData		
bureau	bankrupt	creditScore
Bureau	**Bankrupt**	**Credit Score**
Bureau A	FALSE	600
Bureau A	FALSE	600
Bureau B	FALSE	630
Bureau C	FALSE	720

Datatype BureauData	
String	bureau
boolean	bankrupt
int	creditScore

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Defining Test Data "Application"

Data Application applications					
id	ID	1	2	3	4
riskCategory	Risk Category	?	?	?	?
applicationRiskScore	Application Risk Score	0	0	0	0
eligibility	Eligibility	?	?	?	?
affordability	Affordability	FALSE	FALSE	FALSE	FALSE
creditContingencyFactor	Credit Contingency Factor	0	0	0	0
disposableIncome	Disposable Income	0	0	0	0
pmt	PMT	0	0	0	0
requiredMonthlyInstallment	Required Monthly Installment	0	0	0	0
bureauCallType	Bureau Call Type	?	?	?	?
bureauStrategy	Bureau Strategy	?	?	?	?
routing	Routing	?	?	?	?
loanOriginationResult	Loan Origination Result	?	?	?	?

Datatype Application	
String	id
int	applicationRiskScore
String	riskCategory
double	pmt
double	requiredMonthlyInstallment
double	disposableIncome
double	creditContingencyFactor
boolean	affordability
String	eligibility
String	bureauCallType
String	bureauStrategy
String	routing
String	loanOriginationResult

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Defining Test Data "Test Cases with Expected Results"

DecisionTableTest testCases							
#	ActionUseObject	ActionUseObject	ActionUseObject	ActionUseObject	ActionExpect	ActionExpect	ActionExpect
Test ID	**Applicant**	**Application**	**RequestedProduct**	**BureauData**	**Bureau Strategy**	**Routing**	**Loan Origination Result**
Test 1	:= applicants[0]	:= applications[0]	:= products[0]	:= bureauData[0]	THROUGH	ACCEPT	ACCEPT
Test 2	:= applicants[1]	:= applications[1]	:= products[1]	:= bureauData[1]	BUREAU	DECLINE	DECLINE
Test 3	:= applicants[2]	:= applications[2]	:= products[2]	:= bureauData[2]	DECLINE		DECLINE
Test 4	:= applicants[3]	:= applications[3]	:= products[3]	:= bureauData[3]	DECLINE		DECLINE

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Execution Results for Test 3

```
RUN TEST: Test 3
Decision DetermineLoanOrigination: DetermineApplicationRiskScore
Decision DetermineApplicationRiskScore: ApplicationRiskScore
Conclusion: Application Risk Score = 0 [0]
Conclusion: Application Risk Score += 35 [35]
Conclusion: Application Risk Score += 45 [80]
Conclusion: Application Risk Score += 18 [98]
Decision DetermineLoanOrigination: SubDecisionBureauStrategy
Decision SubDecisionBureauStrategy: DetermineRiskCategoryPreBureau
Decision DeterminePreBureauRiskCategory: PreBureauRiskCategory
Assign: Risk Category = HIGH [HIGH]
Decision SubDecisionBureauStrategy: DetermineAffordability
Decision DetermineAffordability: AffordabilitySubDecisions
Decision AffordabilitySubDecisions: Determine Credit Contingency Factor
Assign: Credit Contingency Factor = 0.6 [0.6]
Decision AffordabilitySubDecisions: Calculate PMT
Assign: PMT = ( Amount * Rate/12 ) / ( 1 - (1 +Rate/12) ** -Term ) [4083.066538617192]
Decision AffordabilitySubDecisions: Determine Required Monthly Installment
Assign: Required Monthly Installment = PMT + 25.00 [4108.066538617191]
Decision AffordabilitySubDecisions: Determine Disposable Income
Assign: Disposable Income = Monthly Income - (Monthly Repayments + Monthly Expenses) [3900.0]
Decision AffordabilitySubDecisions: Determine Affordability
Assign: Affordability = false [false]
Decision SubDecisionBureauStrategy: DetermineBureauStrategy
Decision DetermineBureauStrategy: BureauStrategySubDecisions
Decision BureauStrategySubDecisions: Eligibility
Assign: Eligibility = INELIGIBLE [INELIGIBLE]
Decision BureauStrategySubDecisions: Bureau Call Type
Assign: Bureau Call Type = FULL [FULL]
Decision BureauStrategySubDecisions: Bureau Strategy
Assign: Bureau Strategy = DECLINE [DECLINE]
Decision DetermineLoanOrigination: DetermineLoanOriginationResult
Decision DetermineLoanOriginationResult: Loan Origination Result
Assign: Loan Origination Result = DECLINE [DECLINE]
Validating results for the test <Test 3>
Test 3 was successful
```

Note that Routing never was executed

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Developing Domain-Specific Decision Tables

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Examples of Domain-Specific Decision Tables

DecisionTableCompareRanks CompareDiagnosticNeedWithSensitivityLevel			
Condition	Action	Action	Action
Diagnostic Need Level / Sensitivity Level	**High**	**Mid**	**Low**
Immediately Life-Threatening	**Stronger**	**Stronger**	**Stronger**
Life-Thre			
Acu			
Chro			

Security Domain
(specifies document access)

DecisionTableSpatial EntityToEntityRules

C#	ConditionEntityToEntity					Conclusion	
	Relationship Between Two Entities					**Spatial Significance Score**	
#	Main Entity Type	Relationship	Related Entity Type	Oper	Value		
0						=	0
1	HRR	Contains	HSA	Is	TRUE	+=	2
2	HRR	Touches	HSA	Is	TRUE	+=	1
3	HRR	Is Disjoint From	HSA	Is	FALSE	+=	3
4	HRR+5	Contains	HSA	Is	TRUE	+=	1
5	Route	Crosses	HSA	Is	TRUE	+=	2
6	HRR	Overlaps	County	Is	TRUE	-=	2
7	Airport	Distance	Hospital	<	250	+=	1
8	HRR	Area		<	25	+=	1
9	County	Area		<	25	+=	1
10	HRR	Is Among 25 Closest To	Hospital	Is	TRUE	+=	1
11	Facility	Is Part Of	University	Is	TRUE	+=	1
12	University	Comprises	Facility	Is	TRUE	+=	4

Geo-Spacial Domain

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Beyond DMN: Business DSL

- DMN is a general purpose Decision Modeling Language
  - Defines standard formats for generic decision tables and other decision modeling constructs
- Domain-Specific Decision Modeling is similar to Domain-Specific Languages (DSLs):
  - “Business DSL” provides specialized business concepts, relationships, and formats for a particular problem domain
  - Converting DSL APIs to a “business DSL” using domain-specific decision tables

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Domain-Specific Decision Modeling

- Objective
  - **Given**: a domain-specific language with an API
  - **Goal**: create a domain-specific decision modeling "language" oriented to business users

DSL
(API)

Decision Modeling Constructs
(Diagrams & Decision Tables)

Software Developers

Business Analysts

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How to create a Domain-Specific Decision Table?

1. Start with a domain-specific language (Java API)
2. Design Decision Tables oriented to a subject matter expert in this particular domain
3. Implement **new decision templates** with conditions and actions that support new domain-specific decision tables

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OpenRules Decision Tables

- **Look Inside of OpenRules Implementation**
  - **Business View**
    - **Decision Tables Instances**
  - **Technical View**
    - **Decision Table Templates**
  - **Both defined in Excel**

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Business-oriented Decision Table and its Technical Template

DecisionTable DefineSalutation

Condition		Condition		Condition		Conclusion	
Gender		**Marital Status**		**Date of Birth**		**Salutation**	
Is	Male					Is	Mr.
Is	Female	Is	Married	<	January 1, 2007	Is	Mrs.
Is	Female	Is	Single			Is	Ms.
				>=	January 1, 2007	Is	Little

Rules String DecisionTableTemplate(Decision decision)

[Condition]		[If]	[Conclusion]		[Action]	[Then]	[Ac
decision.compare($COLUMN_TITLE, op, value);		decision.compare($COLUMN_TITLE, expression);	if (decision.isTraceOn()) decision.log("Conclusion: " + $COLUMN_TITLE + " " + op.toString() + " " + value); decision.assign($COLUMN_TITLE,op,value); return null;		decision.assign($COLUMN_TITLE,value); if (decision.isTraceOn()) decision.log($COLUMN_TITLE + ": " + value); return null;	if (decision.isTraceOn()) decision.log($COLUMN_TITLE + " := " + value); decision.assign($COLUMN_TITLE,value); return null;	if (method != n //decision.log method); decision.exe } return null;
Oper op	String value	String expression	Oper op	String value	String value	String value	St
Decision Variable		Variable	Decision Variable		Decision Variable	Decision Variable	Execute

Example: Geospatial Domain

- Deals with objects and algorithms for processing linear geometries (points, lines, areas, etc.) on the 2-dimensional Cartesian plane
- JTS (Java Topology Suite)
  - JTS is a de-facto standard open source Java library with a complete, consistent, and robust Java API
  - However, it is too complex for business users

Equals
Disjoint
Touches
Contains
Covers
Intersects
Within
Covered By
Crosses
Overlaps

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Geospatial Expressions used to define Spatial Significance Score

At least one hospital is within 5 km from the Airport
Between 5 and 15 Hospitals are > 25 km from the Airport
No Hospital is within 10 km from the airport
More than 2 hospitals within 20 km from the Residence
More than 1200 residences within 20 km from the Hospital
HRR has at least 5 HSAs in it
HRR has fewer than 5 HSAs in it
HRR overlaps at least two Counties

HRR – Hospital Referral Region

HSA – Hospital Service Area

- How to present such rules in a “human” way that still can be executed by a computer?

Business Users Like This Format:

New Custom Type of Decision Tables

DecisionTableSpatial EntityToCountsRules

ConditionEntityToCountOfRelatedEntities					Conclusion		
Count of Related Entities					**Spatial Significance Score**		
Main Entity Type	Relationship	Type of Related Entities	Oper	Value			Original Rules
HRR	Contains	HSA	>=	5	+=	2	HRR has at least 5 HSAs in it
HRR	Contains	HSA	<	2	-=	1	HRR has fewer than 5 HSAs in it
HRR	Overlaps	County	>=	2	+=	1	HRR overlaps at least two Countries
Airport	Distance <=5	Hospital	>=	1	+=	5	At least one hospital is within 5 km from the Airport
Airport	Distance >25	Hospital	In	5..15	+=	1	Between 5 and 15 Hospitals are > 25 km from the Airport
Airport	Distance <10	Hospital	<	1	+=	1	No Hospital is within 10 km from the Airport
Residence	Distance <20	Hospital	>	2	+=	1	More than 2 Hospitals within 20 km from the Residence
Hospital	Distance < 15	Residence	>	1200	+=	1	More than 1200 Residences within 15 km from the Hospital
HRR	Distance <=5	Hospital	>	5	+=	3	
Hospital	Distance <=5	Hospital	>	5	+=	3	

JTS Operators

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More Complex Conditions

DecisionTableSpatial EntityToEntityRules							
C#	ConditionEntityToEntity					Conclusion	
#	Relationship Between Two Entities					Spatial Significance Score	
	Main Entity Type	Relationship	Related Entity Type	Oper	Value		
0						=	0
1	HRR	Contains	HSA	Is	TRUE	+=	2
2	HRR	Touches	HSA	Is	TRUE	+=	1
3	HRR	Is Disjoint From	HSA	Is	FALSE	+=	3
4	HRR+5	Contains	HSA	Is	TRUE	+=	1
5	Route	Crosses	HSA	Is	TRUE	+=	2
6	HRR	Overlaps	County	Is	TRUE	-=	2
7	Airport	Distance	Hospital	<	250	+=	1
8	HRR	Area		<	25	+=	1
9	County	Area		<	25	+=	1
10	HRR	Is Among 25 Closest To	Hospital	Is	TRUE	+=	1
11	Facility	Is Part Of	University		TRUE	+=	1
12	University	Comprises	Facility			-=	4

Natural Language Expressions

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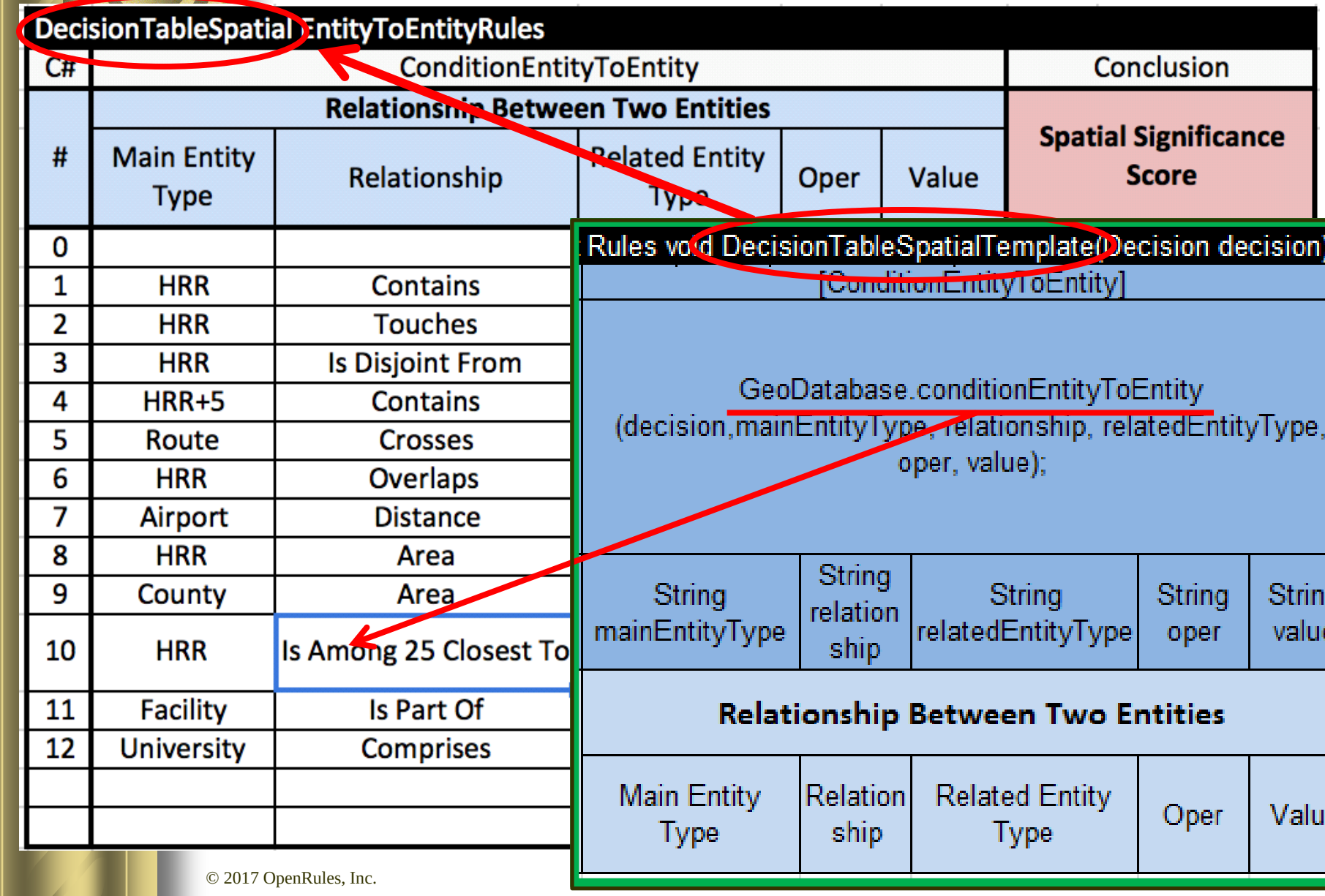
Implementation Template



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Custom Decision Logic: From Java Apps to Decision Models

Programmers	Business Analysts
General Purpose Language (e.g. Java)	BRDMS (DMN)
Domain-specific APIs	Custom Decision Tables
Java Applications	Domain-specific Decision Models

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Conclusion

- OMG DMN is a serious step forward to standardized and interchangeable representations of business decision logic
- Core DMN concepts allow business people to represent, test, and manage their decision models without programming
- Custom Decision Models is a natural replacement of DSL APIs

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QnA

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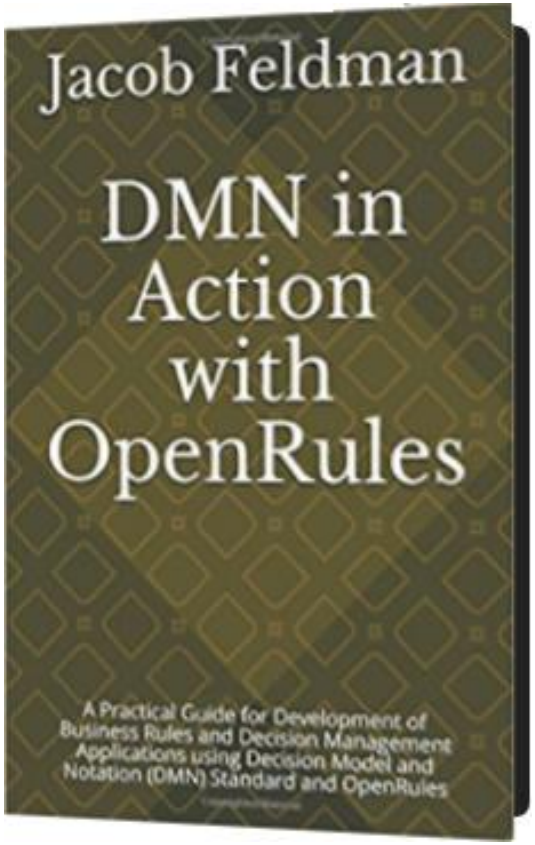

Available at Amazon.com

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