

Decision Management Community June 2017 Challenge

DMN Section 11 Loan Origination Example

The DECISION Team



Contents

- [Challenge Goals](#)
- [Pillars of Sapiens DECISION Methodology](#)
- [The Decision Model \(TDM\)](#)
- [Step 1](#): Business Process: Process Diagrams Reflect Business Practices
- [Step 2](#): Decision Requirements Modeling Using TDM:
 - Top-down Decision Decomposition (Decision Services)
 - Business Glossary
 - Business Logic Re-use
 - Knowledge Source Traceability (from Requirements to Execution)
- [Step 3](#): Decision Logic Modeling Using TDM*:
 - Hit Policy Auto-selection
 - Conformance Levels
 - Decision Table validation
 - Business Views
 - Messages (aka Rule Annotations)
 - Testing
 - Data Acceptance
- [Recap](#)
- [In Summary](#)

*For clarity and brevity, not all the decision tables are presented herein.

Challenge Goals: Methodology Best Practices

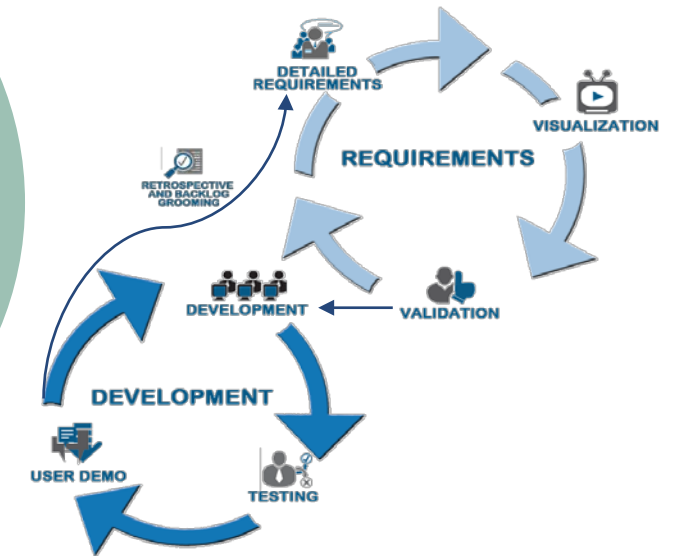
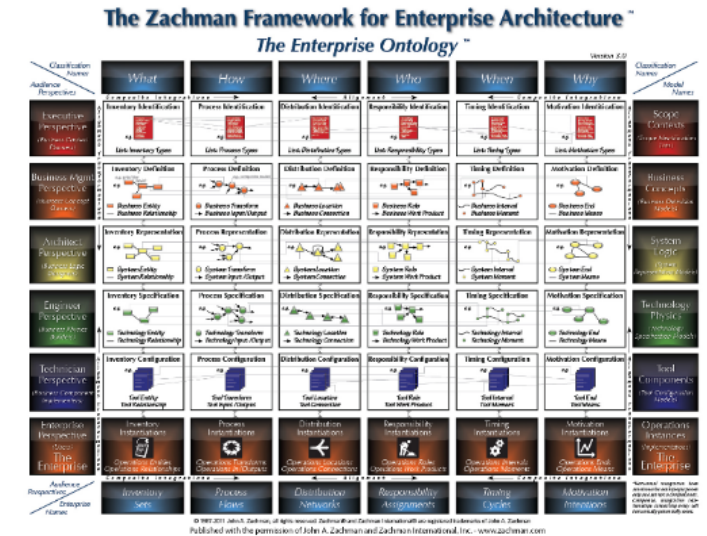
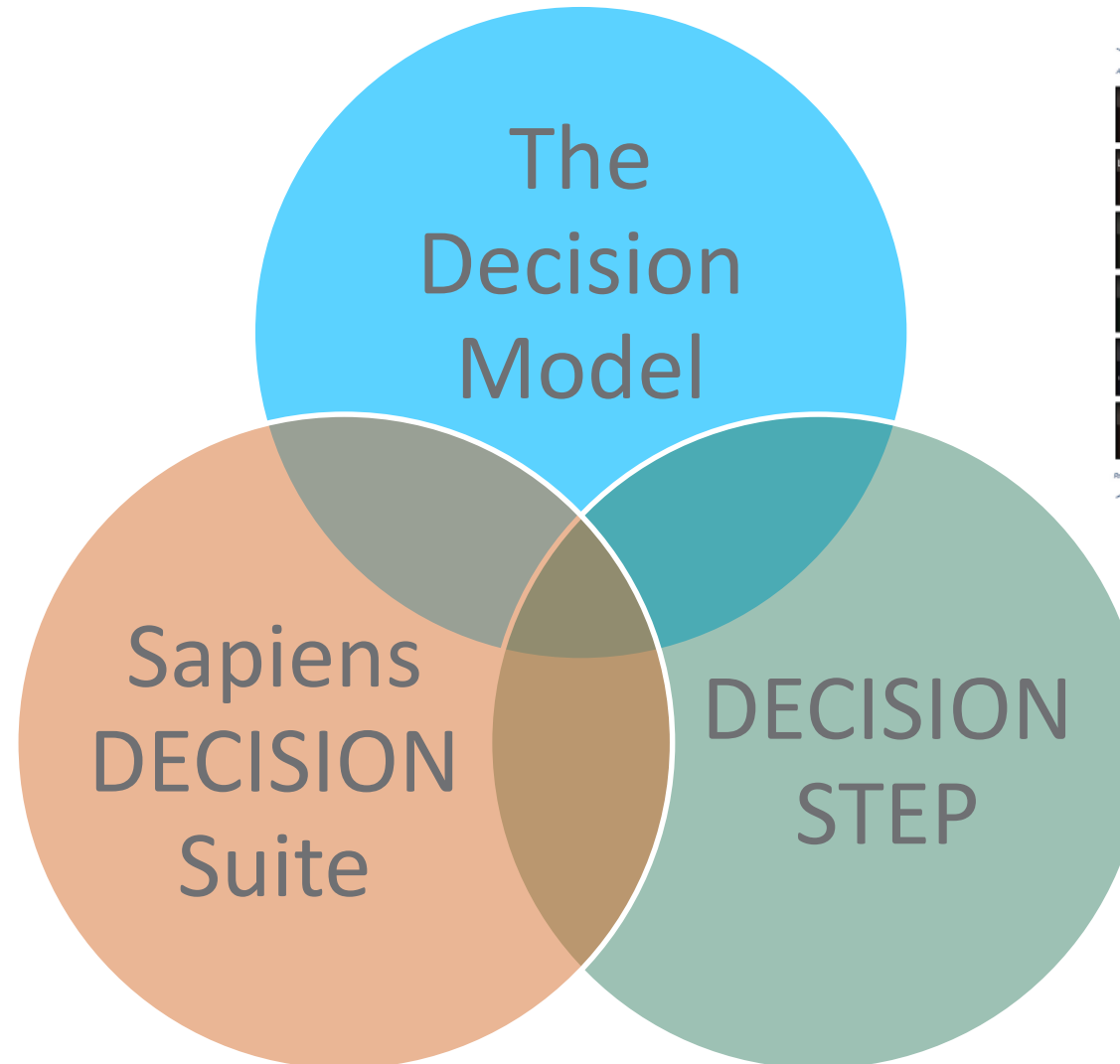
[The challenge goals](#) are to showcase decision management methodology best practices put to bear by practitioners in solving the Loan Origination business problem documented in the DMN specification

*“This challenge is not a competition of tools... Submitters may use these or any other tool to demonstrate how to create loan origination decision models which they consider to be the **best from business (!)** decision modeling, execution, and further maintenance **perspectives**. ”*

DM Community Web-site

Pillars of DECISION Methodology: Reinforcing One Another

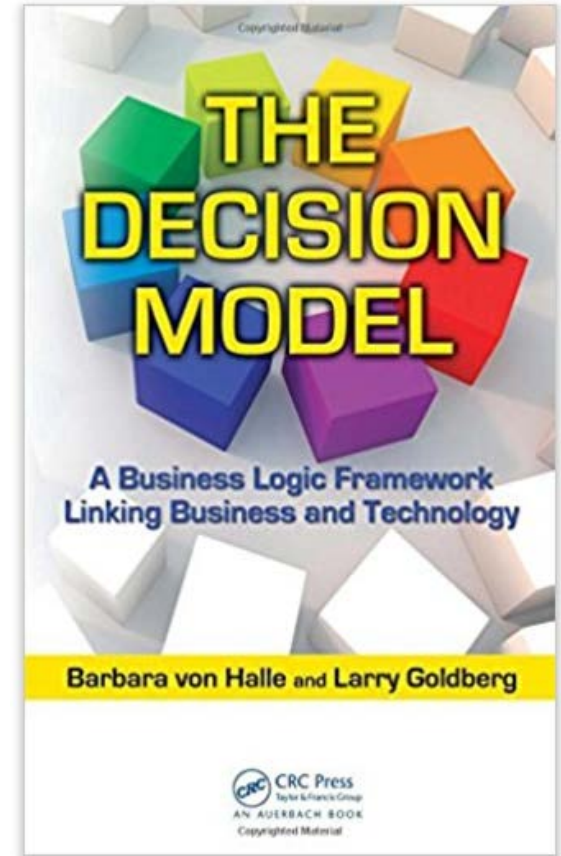
- [The Decision Model](#) (TDM) - a formal business logic representation method underpinning the Sapiens DECISION approach to Decision Management
- [Sapiens DECISION](#) – a six-year-old enterprise suite of products implementing TDM from business requirements through execution, that is used to model, test, and execute the Loan Origination challenge
- [DECISION STEP](#) – a requirements gathering & management methodology influenced by the Zachman framework, and an Agile-based project delivery methodology used to deliver the challenge solution



The Decision Model: Sapiens DECISION Methodology

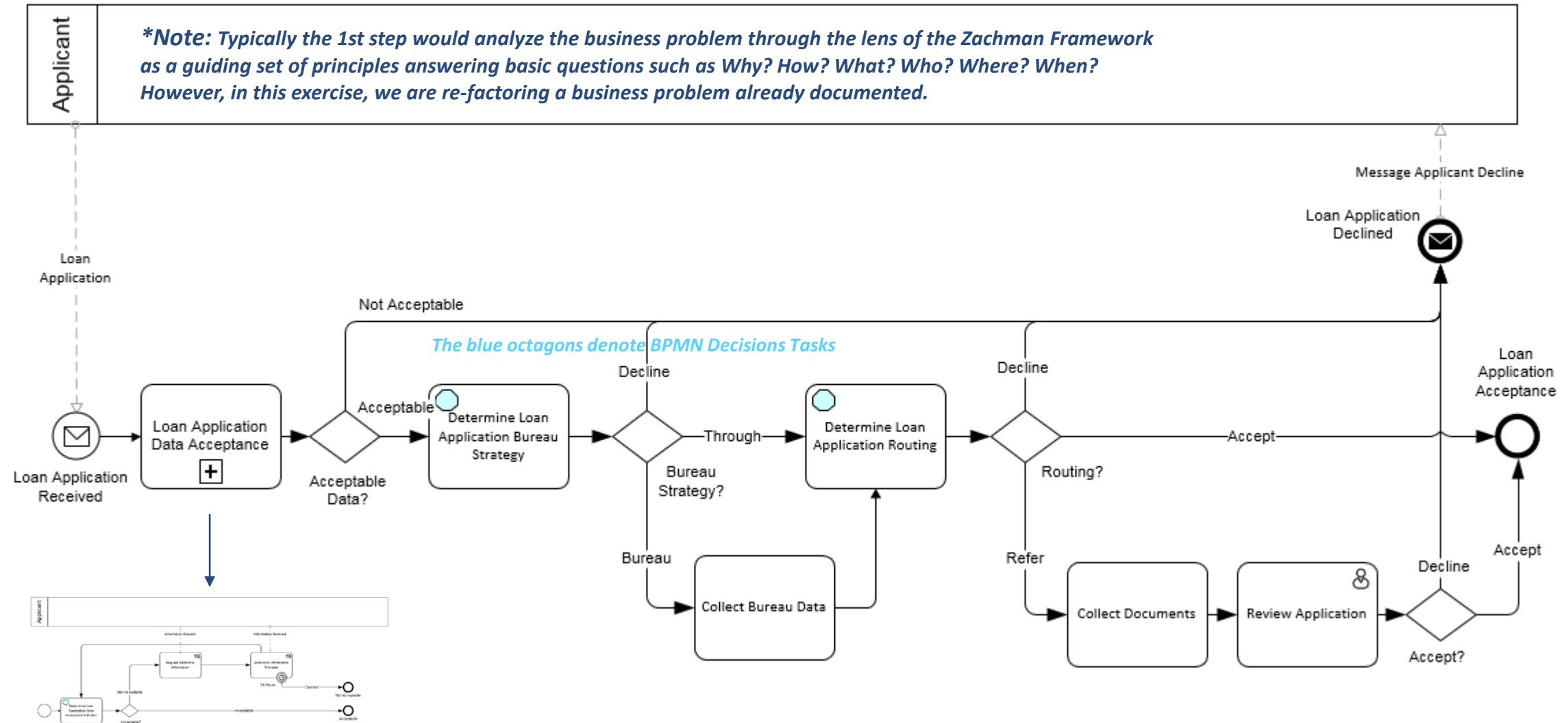
The Decision Model (TDM) is a way of representing business logic that is platform and technology independent. It models logic based on the inherent structure of that logic, eliminating style and other subjective preferences, ensuring a consistent and stable representation.

In the subsequent sections we define the TDM process in a nutshell, as a series of iterative, high-level steps to be taken.



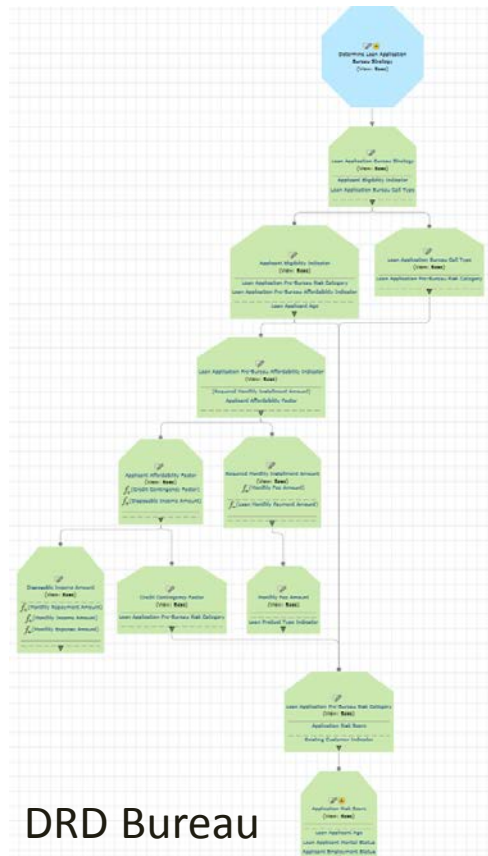
“The Decision Model: A Business Logic Framework Linking Business and Technology” (von Halle & Goldberg) © 2009

Step 1*: Define the Business Process, and Where Business Decisions are Made

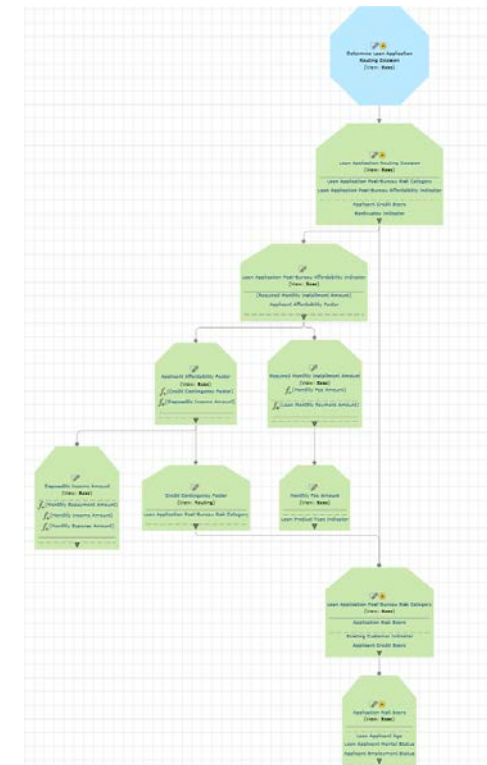


Process Models Reference Decisions the Business Cares About

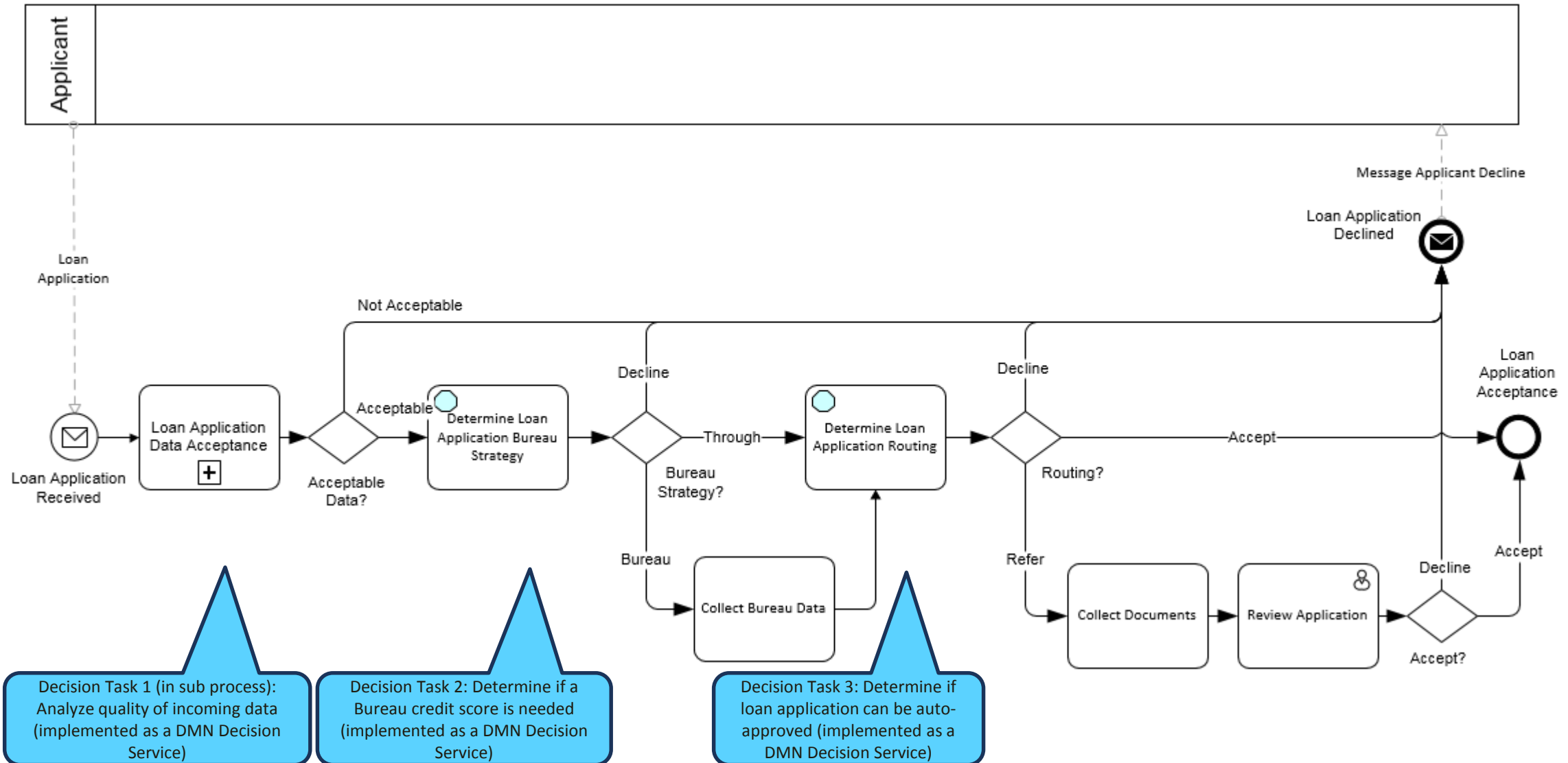
Can a loan be approved without accessing a credit bureau for a credit score? A BPMN Decision Task invokes a DMN Decision Service to find out



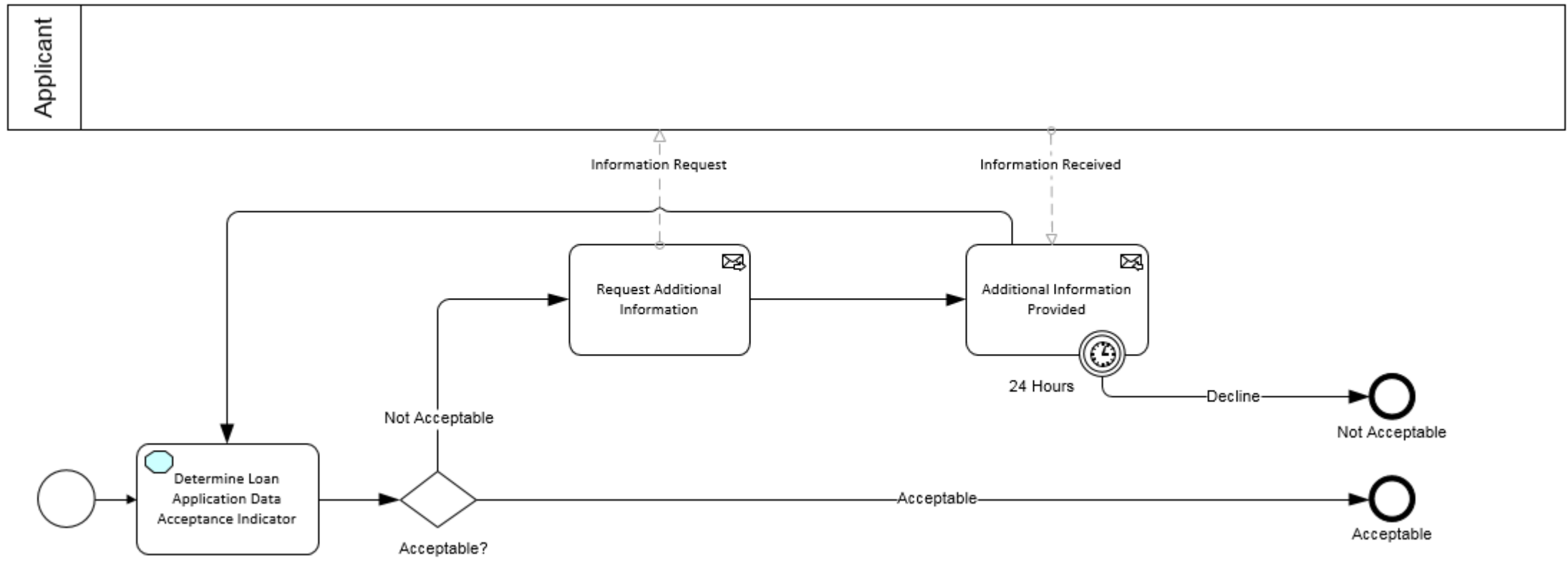
Can a loan be auto-approved without human intervention? A BPMN Decision Task invokes a DMN Decision Service to find out



Decision Tasks Invoke DMN Decision Services



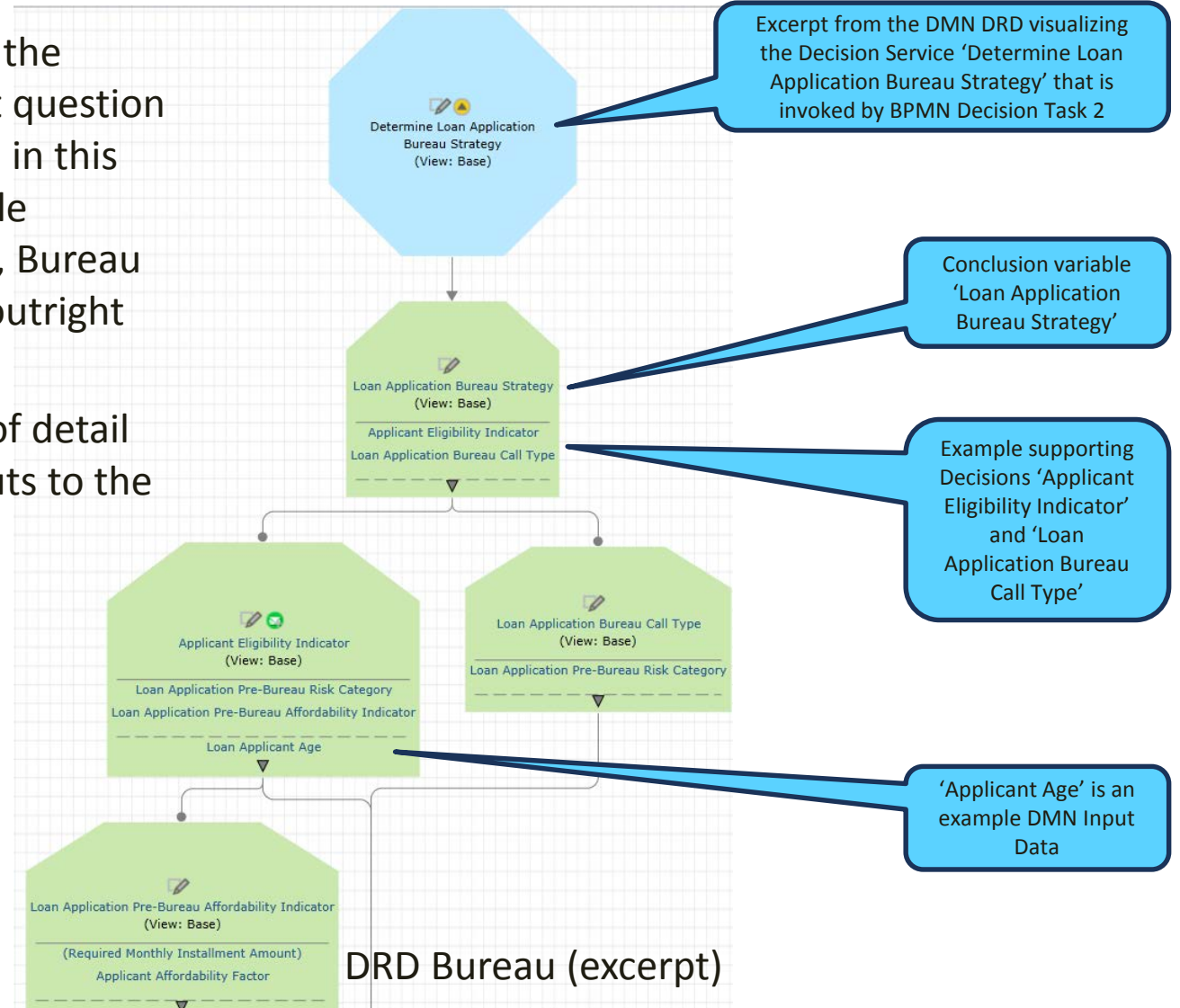
Data Acceptance Sub Process



Decision Task 1 (in sub process):
Analyze quality of incoming data
(implemented as a DMN Decision
Service)

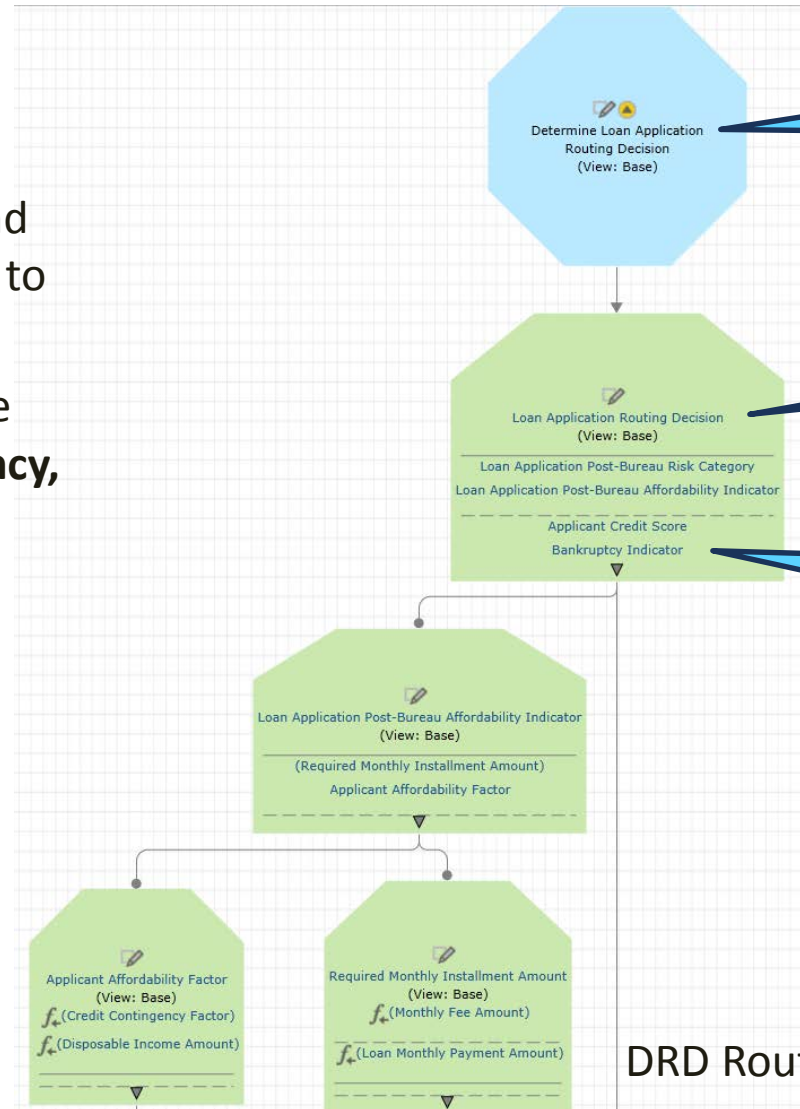
Step 2: Decision Requirements/Top-down Decision Decomposition

- Each **Decision Service** answers a single question that the business cares about and would like to maintain. That question defines a conclusion variable for the Decision Service, in this case 'Loan Application Bureau Strategy' with 3 possible answers: Through (no need for a bureau credit score), Bureau (acquiring of credit score is necessary), and Decline (outright decline of application)
- From there, **top-down modeling** is done to the level of detail necessary such that all attributes are available as inputs to the model



Decision Requirements/Top-down Decision Decomposition (Cont'd)

- DMN DRDs allow **filtering** out graphical elements that may not be needed for a particular visualization purpose. This example, removes Knowledge Source, and depicts the Input Data elements internal to the Decision shape
- As new attributes are uncovered they are added to the **glossary to foster consistency, and re-use**



Excerpt from the DRD visualizing the Decision Service for determining if a loan application can be auto-approved that is invoked by BPMN Decision Task 3

Conclusion variable 'Loan Application Routing Decision'

Model is strictly top down in terms of supporting vs. supported Decisions; it is self-scoping in that modeler can choose how deep to develop business logic and which attributes will be inputs to the model (e.g. 'Bankruptcy Indicator')

DRD Routing (excerpt)

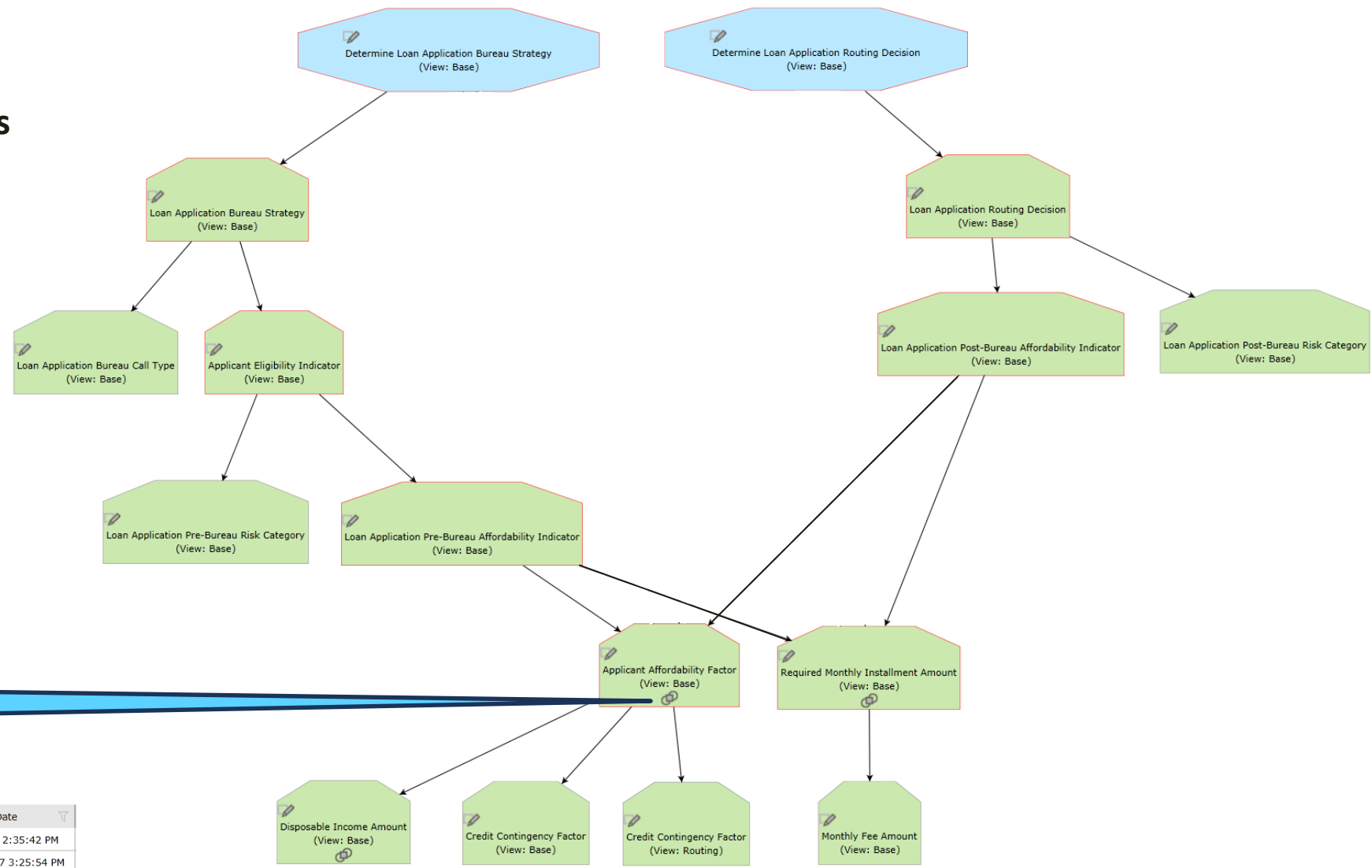
TDM Business Glossary

- The glossary contains an entry and meta data about every attribute in a community of decision models. This ensures **consistency** of terminology across decision models and **maximum re-use** of business assets
- There may be multiple glossaries in an enterprise and they are arranged hierarchically so as to afford re-use but also distinctions between the terms used by different organizations within the enterprise
- Glossaries capture the **business-friendly** attribute names, business-friendly attribute types, and business-friendly, not technical, allowed values for these attributes. Technical resources may map the business-friendly names and values to one or more technical models
- The attributes in a particular glossary are organized by Business Concepts such as Applicant, or Application

Business Friendly Name	Business Concept	Type	Valid Values
Applicant Affordability Factor	Applicant	AMOUNT	
Applicant Credit Score	Applicant	QUANTITY	
Applicant Eligibility Indicator	Applicant	INDICATOR	Eligible, Ineligible
Applicant Employment Status	Applicant	CODE	Employed, Self-Employed, Student, Unemployed
Applicant Loan Data	Applicant	TEXT	
Bankruptcy Indicator	Applicant	INDICATOR	False, True
Credit Contingency Factor	Applicant	NUMERIC	
Existing Customer Indicator	Applicant	INDICATOR	Existing, Non-Existing
Loan Applicant Age	Applicant	QUANTITY	
Loan Applicant Marital Status	Applicant	INDICATOR	Married, Single
Loan Application Bureau Call Type	Application	CODE	Full, Mini, None
Loan Application Bureau Strategy	Application	CODE	Bureau, Decline, Through
Loan Application Data Acceptance Indicator	Application	INDICATOR	Acceptable, Not Acceptable
Loan Application Post-Bureau Affordability Indicator	Application	INDICATOR	Affordable, Not Affordable
Loan Application Post-Bureau Risk Category	Application	CODE	High, Low, Medium, Very Low
Loan Application Pre-Bureau Affordability Indicator	Application	INDICATOR	Affordable, Not Affordable
Loan Application Pre-Bureau Risk Category	Application	TEXT	Decline, High, Low, Medium, Very Low
Loan Application Risk Score	Application	QUANTITY	
Loan Application Routing Decision	Application	CODE	Accept, Decline, Refer
Monthly Disposable Income Amount	Cash Flow	AMOUNT	
Monthly Income Amount	Cash Flow	AMOUNT	
Monthly Expense Amount	Cash Flow	AMOUNT	
Monthly Fee Amount	Cash Flow	AMOUNT	
Monthly Payment Amount	Cash Flow	AMOUNT	
Monthly Repayment Amount	Cash Flow	AMOUNT	
Monthly Required Installment Amount	Cash Flow	AMOUNT	
Loan Product Type Indicator	Product Type	INDICATOR	Special, Standard

TDM Business Logic Re-use

- This DRD serves to visualize the interactions between 2 Decision Services and the **re-used business assets** that they share



Re-use details

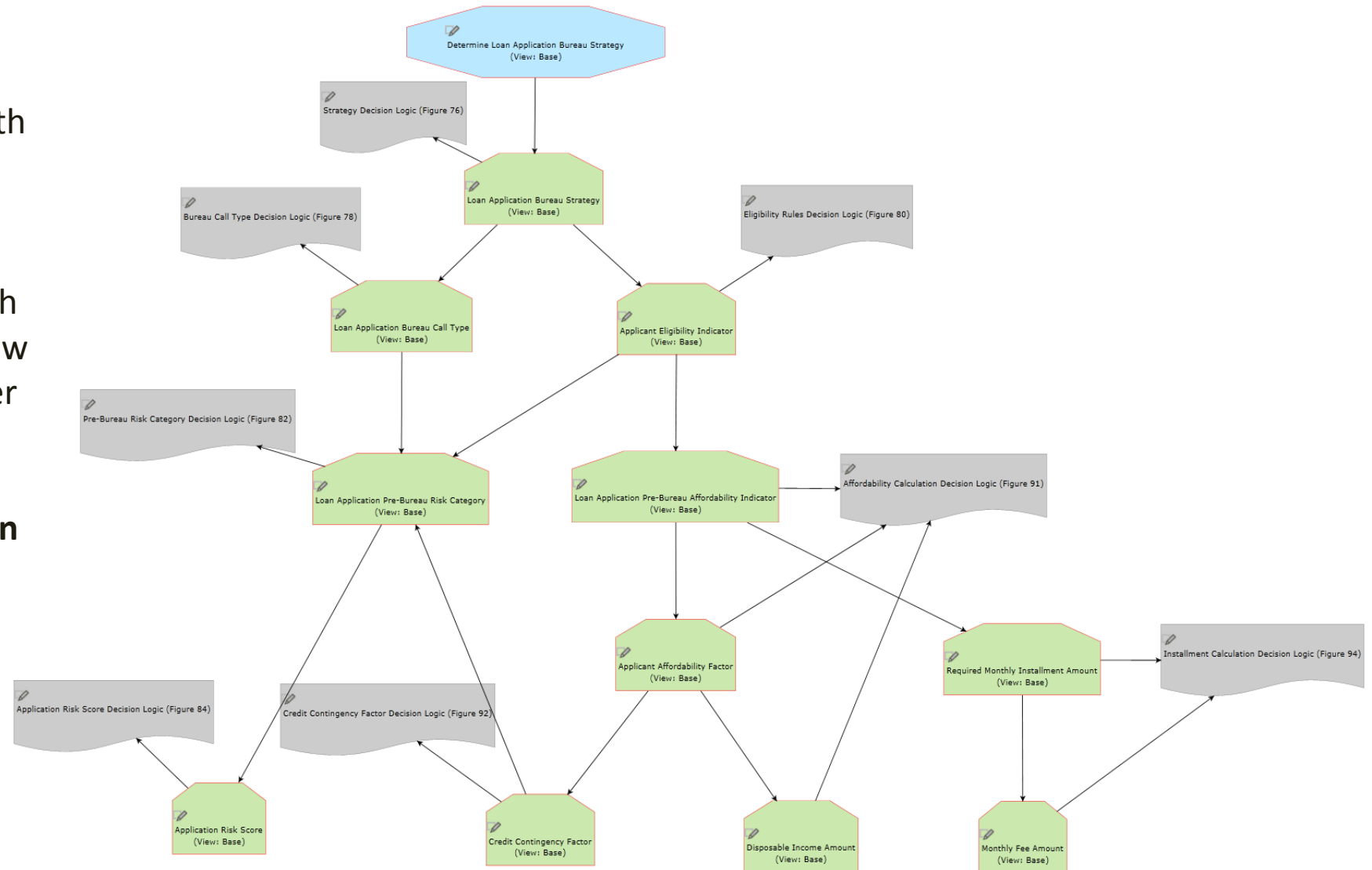
Indicator that a Decision is re-used

Applicant Affordability Factor References

Name	Status	Created By	Created Date
Determine Loan Application Bureau Strategy (View: Base) V0	DRAFT	Sherry Stanley	6/8/2017 2:35:42 PM
Determine Loan Application Routing Decision (View: Base) V0	DRAFT	Sherry Stanley	6/12/2017 3:25:54 PM

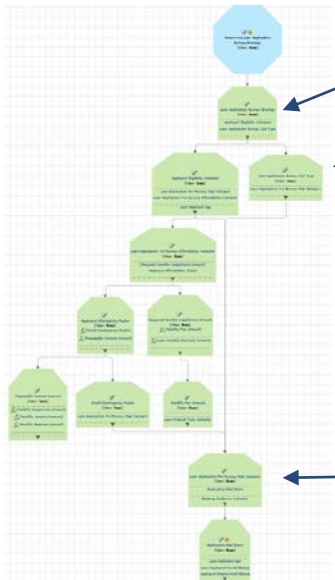
Knowledge Source Traceability (from Requirements to Execution)

- Complete DRD for the Decision Service 'Determine Loan Application Bureau Strategy' with Knowledge Sources for each Decision
- Knowledge Sources can form a hierarchy, can be associated with an individual Decision, with a row in a Decision Table, or with other model assets as needed
- Sapiens DECISION traces **Knowledge Sources to execution information** at the transaction level



Step 3: Decision Logic Modeling

- Each Decision is modeled as a Decision Table where the logic adheres to the **15 principles of TDM** (see [The Decision Model: A Business Logic Framework Linking Business and Technology](#))
- The DECISION Manager module used for modeling as part of the Sapiens DECISION product suite validates that the logic complies with the principles to ensure that it is executable and can be used to generate code



Applicant Eligibility Indicator		Loan Application Bureau Call Type		Loan Application Bureau Strategy	
Is	Ineligible			Is	Decline
Is	Eligible	Is In	{Full,Mini}	Is	Bureau
Is	Eligible	Is	None	Is	Through

Loan Application Pre-Bureau Risk Category		Loan Application Bureau Call Type	
Is In	{High,Medium}	Is	Full
Is	Low	Is	Mini
Is In	{Decline,Very Low}	Is	None

Existing Customer Indicator		Application Risk Score		Application Risk Score		Loan Application Pre-Bureau Risk Category	
Is	Non-Existing	Is Less Than	100			Is	High
Is	Non-Existing	Is Greater Than or Equal To	100	Is Less Than	120	Is	Medium
Is	Non-Existing	Is Greater Than or Equal To	120	Is Less Than	130	Is	Low
Is	Non-Existing	Is Greater Than or Equal To	130			Is	Very Low
Is	Existing	Is Less Than	80			Is	Decline
Is	Existing	Is Greater Than or Equal To	80	Is Less Than	90	Is	High
Is	Existing	Is Between	{90,110}			Is	Medium
Is	Existing	Is Greater Than	110			Is	Low

TDM Hit Policy Auto-selection

TDM simplifies the selection of DMN Hit Policy by selecting the appropriate Hit Policy dependent on the modeled business logic.

In this example, there are overlapping rows and the table validation ensures that only one conclusion value can be reached for a given set of valid input data. The Hit Policy utilized is 'Any'.

Note that this decision table uses as its Knowledge Source Figure 86 in the specification solution. That table uses a 'Priority' Hit Policy that we do not recommend as it is harder to interpret and validate.

In this example, there may be multiple rows of logic 'firing' for a single set of data, and the results are aggregated as in the DMN 'Collect' with 'SUM' aggregation Hit Policy.

There are Hit Policies that we do not recommend or support such as First, and Priority.

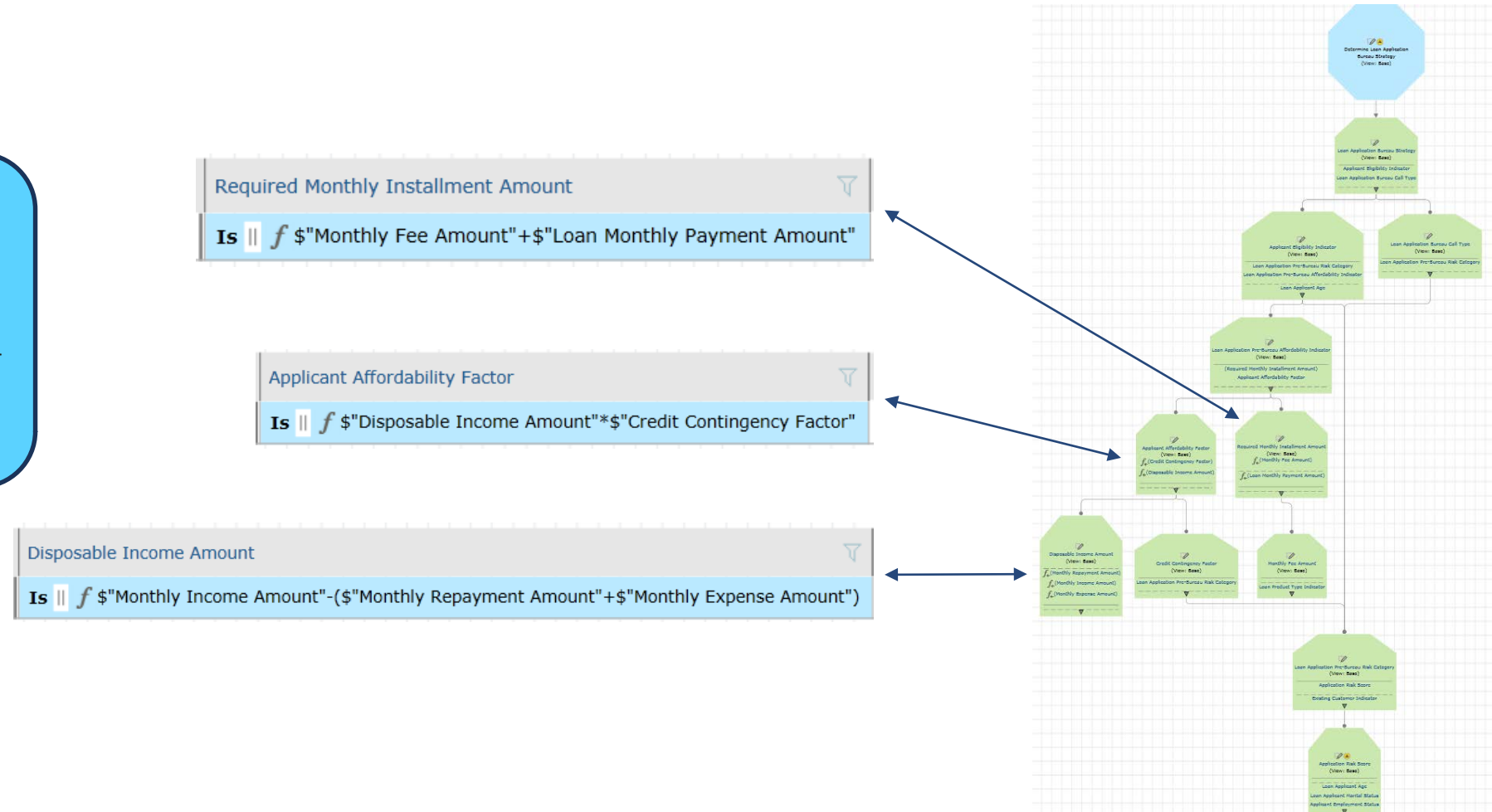
Loan Application Post-Bureau Affordability Indicator	Bankruptcy Indicator	Loan Application Post-Bureau Risk Category	Applicant Credit Score	Loan Application Routing Decision
Is v Affordable	Is v False	Is In v {Low,Medium,Very Low}	Is Greater Than or Equal To v 580	Is v Accept
Is v Not Affordable				Is v Decline
Is v Affordable	Is v True			Is v Decline
Is v Affordable	Is v False	Is v High		Is v Refer
Is v Affordable	Is v False	Is In v {Low,Medium,Very Low}	Is Less Than v 580	Is v Refer

Determine Loan Application Bureau Strategy (View: Base) V0				
Application Risk Score (View: Base) V0 - DRAFT				
Pattern	Applicant Age	Applicant Marital Status	Applicant Employment Status	Application Risk Score
1	Is Between v {18,21}			Is Incremented By v 32
1	Is Between v {22,25}			Is Incremented By v 35
1	Is Between v {26,35}			Is Incremented By v 40
1	Is Between v {36,49}			Is Incremented By v 43
1	Is Greater Than or Equal To v 50			Is Incremented By v 48
2		Is v Single		Is Incremented By v 25
2		Is v Married		Is Incremented By v 45
3			Is v Unemployed	Is Incremented By v 15
3			Is v Student	Is Incremented By v 18
3			Is v Employed	Is Incremented By v 45
3			Is v Self-Employed	Is Incremented By v 36

DMN Conformance Levels

Generally speaking we believe that sticking to Conformance Level 2 enhances readability of logic models by non-technical staff. In this example, an expression in a conclusion column calculates 'Disposable Income Amount'.

More complex and rarely modified functions such as PMT can be defined as user-defined functions and then used in decision table cells in the same way as any built-in function.



TDM Decision Table Validation Examples

Example of overlapping cell values in rows 2 & 3 of a decision table; both rows test for the value 'Medium' so that 2 contradictory conclusions would be reached (0.7 and 0.9). This is not allowed.

Determine Loan Application Bureau Strategy (View: Base) V0

Credit Contingency Factor (View: Base) V0 - DRAFT

Row ID	Pattern	Loan Application Pre-Bureau Risk Category	Credit Contingency Factor
2454208	1	Is In {Decline,High}	Is 0.6
2454213	1	Is Medium	Is 0.7
2517269	1	Is In {Medium,High}	Is 0.9
2454219	1	Is In {Low,Very Low}	Is 0.8

RFV : Validation Credit Contingency Factor (View: Base) V0

Drag a column header and drop it here to group by that column

#	Severity	Principle	Content	Row Ids
1	⚠	P12	Rule Family View has two overlapping rules in rows : "2454213" and "2517269"	[2454213][2517269]
2	⚠	P12	Rule Family View has two overlapping rules in rows : "2454208" and "2517269"	[2517269][2454208]

Two validation messages: (1) Overlapping rows (top and bottom rows) with differing conclusions, and (2) lack of full coverage for the domain values of attribute 'Loan Applicant Employment Status' (the value 'Not Employed' is not explicitly used)

Determine Loan Application Bureau Strategy (View: Base) V0

Applicant Eligibility Indicator (View: Base) V0 - DRAFT

Loan Application Pre-Bureau Risk Category	Loan Application Pre-Bureau Affordability Indicator	Loan Applicant Age	Loan Applicant Employment Status	Applicant Eligibility Indicator
Is In {High,Low,Medium,Very Low}	Is Affordable	Is Greater Than or Equal To 18		Is Eligible
Is Decline				Is Ineligible
	Is Not Affordable			Is Ineligible
		Is Less Than 18		Is Ineligible
			Is Employed	Is Ineligible

RFV : Validation Applicant Eligibility Indicator (View: Base) V0

Drag a column header and drop it here to group by that column

#	Severity	Principle	Content	Row Ids
1	⚠	P12	Rule Family View does not use all Domain values for Condition Fact Type "Loan Applicant Employment Status"	
2	⚠	P12	Rule Family View has two overlapping rules in rows : "2438882" and "2517291"	[2438882][2517291]

TDM Re-use thru Business Views

The 'Credit Contingency Factor' attribute is utilized in multiple contexts. Although the conclusion variable is identical, the business logic to derive the conclusion is not.

TDM introduces a Business View to accommodate this need for re-use of business assets. In this example, there is a 'Base' view and a 'Routing' view. Both decision tables conclude the 'Credit Contingency Factor' but based on differing logic.

This is a simple example, but in practice the concept is very powerful such as when modeling different logic for the same conclusion across several geographical jurisdictions.

Determine Loan Application Routing Decision (View: Base) V0				
Credit Contingency Factor (View: Routing) V0 - DRAFT				
Pattern	Loan Application Post-Bureau Risk Category		Credit Contingency Factor	
1	Is	v High	Is	v 0.6
1	Is	v Medium	Is	v 0.7
1	Is In	v {Low,Very Low}	Is	v 0.8

Determine Loan Application Bureau Strategy (View: Base) V0				
Credit Contingency Factor (View: Base) V0 - DRAFT				
Pattern	Loan Application Pre-Bureau Risk Category		Credit Contingency Factor	
1	Is In	v {Decline,High}	Is	v 0.6
1	Is	v Medium	Is	v 0.7
1	Is In	v {Low,Very Low}	Is	v 0.8

TDM Messages (aka Rule Annotations)

Row-level message definitions

Loan Application Pre-Bureau Risk Category	Loan Application Pre-Bureau Affordability Indicator	Loan Applicant Age	Applicant Eligibility Indicator	Critical
Is In {High,Low,Medium,Very Low}	Is Affordable	Is Greater Than or Equal To 18	Is Eligible	
Is Decline			Is Ineligible	"Loan is Ineligible due to a Loan Application Pre-Bureau Risk Category of Decline"
	Is Not Affordable		Is Ineligible	"Loan is Ineligible due to Loan Application Pre-Bureau Affordability Indicator of Not Affordable"
		Is Less Than 18	Is Ineligible	"Loan is Ineligible due to Loan Applicant Age of "+Loan Applicant Age%" that "+(Operator:Loan Applicant Age)+" "+(Value:Loan Applicant Age)"

- Messages are defined at the **row level in a decision table** and during execution they are returned for each row that fires, that is, when row conditions are met
- **Multiple categories** of messages may be defined for each decision table to accommodate varying audience levels, to record analytics information, to communicate with downstream systems, or for other purposes
- Messages (aka Rule Annotations) were recently voted into the DMN specification by the OMG DMN Task Force for version 1.2

TDM Messages (aka Rule Annotations)

ID	Executed	Actions	Expected Result	Execution Result	Loan Applicant Age	Loan Application Pre-Bureau Affordability Indicator	Loan Application Pre-Bureau Risk Category
2517333				Ineligible	15	Not Affordable	
Row ID	Message Category	Message Content					
^ 2438912							
	Critical	Loan is Ineligible due to Loan Applicant Age of 15 that Is Less Than 18					
^ 2438917							
	Critical	Loan is Ineligible due to Loan Application Pre-Bureau Affordability Indicator of Not Affordable					

A single test case

Output messages

- In the example above, an ‘Any’ Hit Policy was automatically determined based on the defined business logic, and execution caused 2 rows to fire. Both rows concluded ‘Ineligible’ and that is the conclusion returned as the decision table result
- **Each row produces a different message that can help explain the result.** In this case, both the ‘Applicant Age’ (15) and the ‘Loan Application Pre-Bureau Affordability Indicator’ (‘Not Affordable’) were non compliant with the business policy

TDM Testing

- Testing by the business modeler is a critical element of the model development process
- Testing is performed at the decision table level, for each decision table. Typically, decision table testing is comprehensive for all possible attribute values
- Next, testing is performed at the decision service level. For complex services, branch testing may also occur
- Finally, process-level testing is performed
- Test suites are **typically exported and provided to IT** for acceptance and regression needs



TDM Data Acceptance

- Data Acceptance (DA) is an additional process step that ensures that decision model conclusions are **reliable** by checking input data against model expectations
- In most cases, failures at the DA step result in aborting of the transaction
- DA logic does not replicate QA done by IT; it is **business-level logic**
- **DA dimension** Examples:
 - Completeness (always required, conditionally required, optional)
 - Domain Validity – The determination that an attribute value falls within the fact type's valid range
 - Consistency – The determination that a fact value makes business sense in the context of related attribute values
 - Reasonableness – The determination that an attribute value conforms to predefined reasonability limits
 - Accuracy – The determination that a fact value (regardless of the source) approaches its true value. (e.g. accuracy to authoritative source, accuracy to real world data, accuracy to an independent calculation)

Recap

What was accomplished:

1. Process model defined
2. Identified tasks in the process model that invoke decision services (added a data acceptance service to increase reliability)
3. Developed each decision service in top-down fashion
4. Implemented decision table logic for each decision in the decision services
5. Validated and tested each decision table
6. Validated and tested each decision service
7. Validated and tested the process flow

Congratulations! You now have ready-to-execute **business assets**

In Summary

- TDM **guardrails** help constrain DMN to boost its productivity and ensure models are executable
- Decision modeling and process modeling work well in **tandem**
- Decision Requirement Diagrams (DRDs) are most helpful when they help define **Decision Services** that are invoked by BPMN Decision Tasks
- A **top-down** modeling strategy ensures a systematic and self-scoping modeling process
- **Robust** TDM concepts such as a Federated Business Glossary, Business Views, and Messaging are part of a comprehensive Decision Management methodology and mature tool-set
- Comprehensive testing performed by the Business ensures robust models and **fast time-to-market**
- Data Acceptance ensures **high-quality** decision **results**

Happy Modeling!



Thank You

Please visit us at www.sapiensdecision.com

SAPIENS
DECISION
www.sapiensdecision.com