

# Business-Composable Services for the Mortgage Industry

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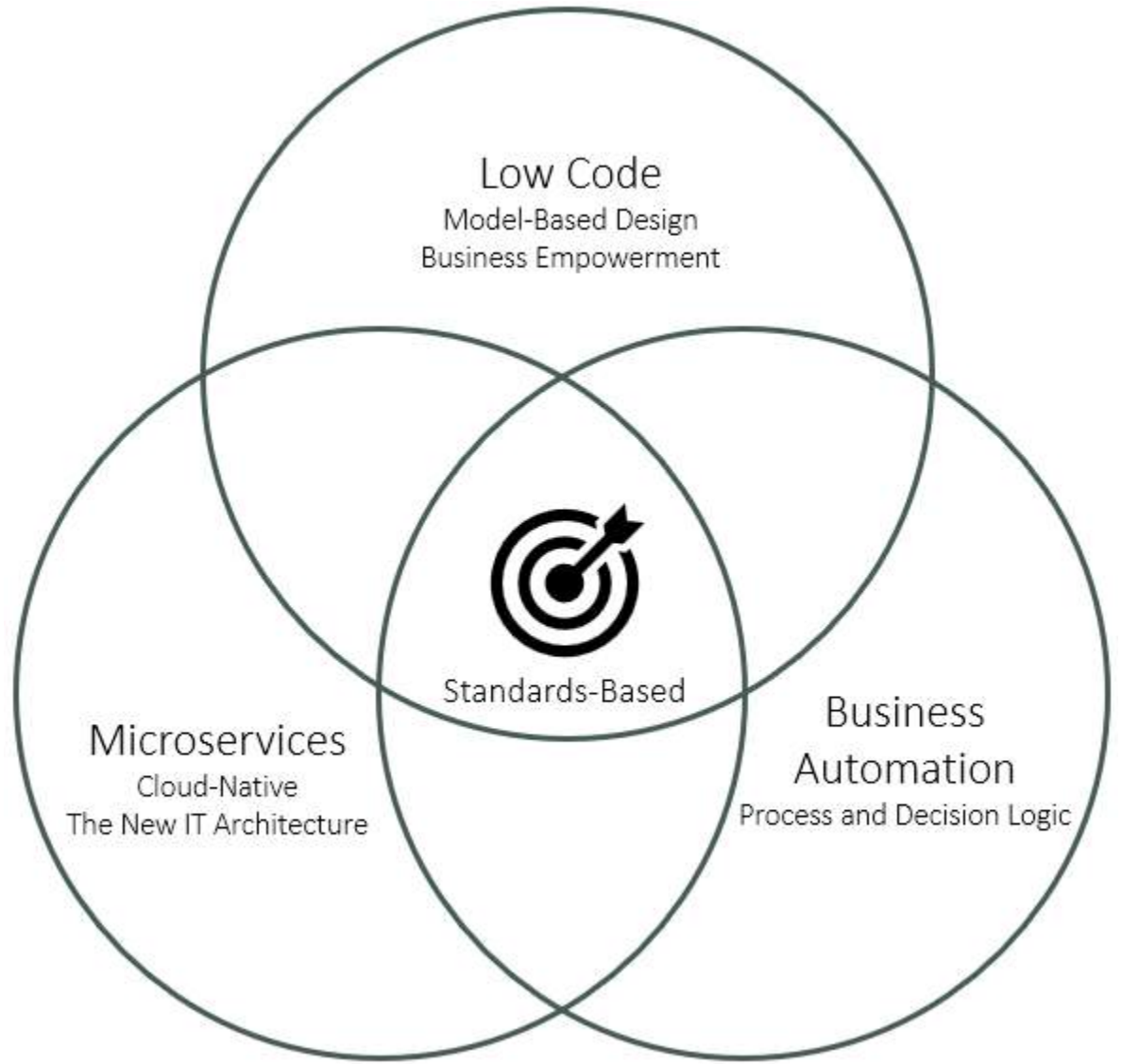
# The New Sweet Spot

Business Automation

Low Code

Cloud-Native Microservices

...Based on Industry Standards



# DMN Hits the Target

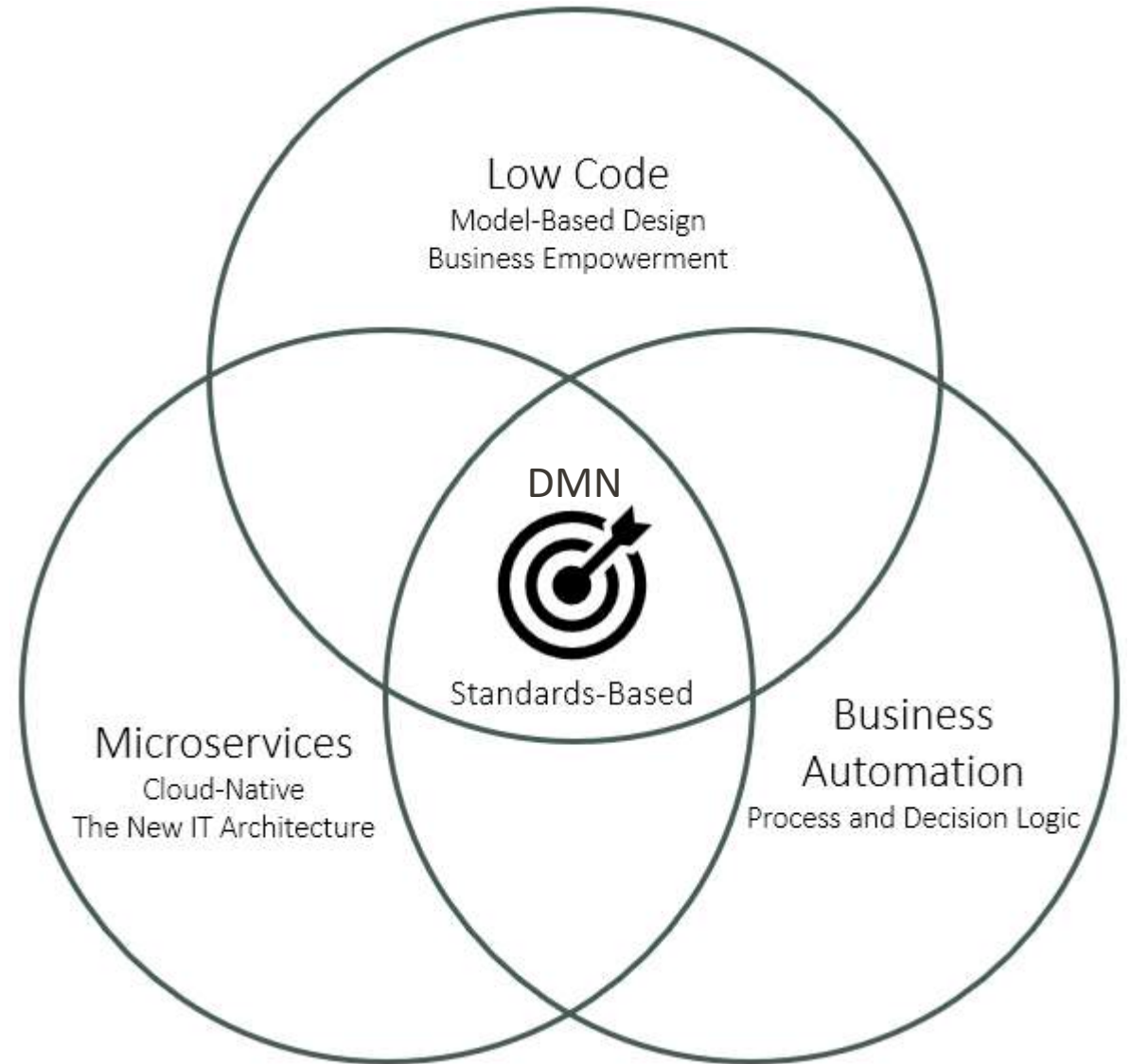
Model-based design

FEEL

Boxed expressions

Decisions exposed as stateless services

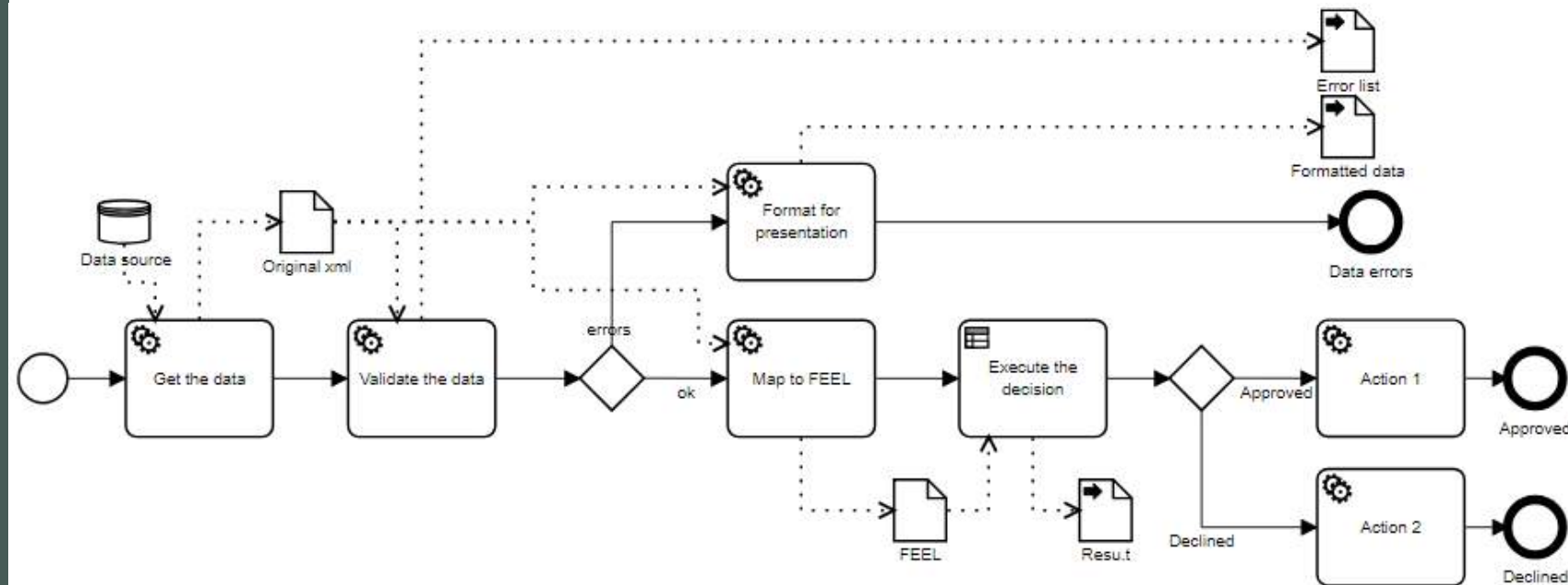
One-click cloud deployment



... But  
Decisions  
Need Process  
Orchestration,  
too

## It's all about the data

- Get the input data
- Validate it
- Format it for presentation and editing
- Map it to DMN-friendly FEEL
- Take action on the decision result





# Business- Enabling Executable BPMN

## Borrowing from DMN...

- Business-friendly expressions
  - FEEL
- Business-friendly service invocation
  - Boxed invocation
- One-click deployment
  - ... as a REST service in the cloud
- ... now provided in Trisotech platform

# XML Data and FEEL

## Trisotech system features

- Create FEEL datatypes from XSD import (BPMN, DMN)
- Map XML data to corresponding FEEL data (“Context parser”)
- BPMN service tasks use FEEL boxed invocation
- Data input/output mapping use boxed context
- BPMN gateway conditions are FEEL expressions

# Business-Composable Services for the Mortgage Industry

Platform provides...

- Business-composable decision logic
- Business-composable flow logic
- One-click service deployment and execution
- Connectors to common data sources

... but also need...

- Utility services
  - Data validation
  - Data formatting for presentation and completion
  - Data transformation to DMN-friendly format
- User-modifiable decision services
- User-modifiable process services
- Runtime-only services

# Mortgage Loan Origination

- New MISMO XML schema standardizes loan data storage and communication

## BORROWER

Information specific to the person making the loan; also known as the mortgagor or obligor.

## COUNSELING

```
no.org/residential/2009/schemas" xmlns:xs="http://www.w3.org/2001/XMLSchema-
deextension.org/Schema/ULAD" xmlns:DU="http://www.w3.org/2001/XMLSchema-
ner="3.4.032420160128" xmlns:xlink="http://www.w3.org/1999/xlink"
idential/2009/schemas DU_Wrapper_3.4.0_B324.xsd">
<ASSETS>
  <ASSET SequenceNumber="1" xlink:label="ASSET_1">
    <ASSET_DETAIL>
      <AssetAccountIdentifier>123456</AssetAccountIdentifier>
      <AssetCashOrMarketValueAmount>12000.00</AssetCashOrMarketValueAmount>
      <AssetType>CheckingAccount</AssetType>
    </ASSET_DETAIL>
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      <NAME>
        <FullName>Bank of Noosh</FullName>
      </NAME>
    </ASSET_HOLDER>
  </ASSET>
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      <AssetCashOrMarketValueAmount>100000.00</AssetCashOrMarketValueAmount>
      <AssetType>CertificateOfDepositTimeDeposit</AssetType>
    </ASSET_DETAIL>
    <ASSET_HOLDER>
      <NAME>
        <FullName>Bank of Noosh</FullName>
      </NAME>
    </ASSET_HOLDER>
  </ASSET>
</ASSETS>
<DEALS>
  <DEAL>
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    <DataVersionName>DU Fixed Primary Attached v3.4 DI-C01</DataVersionName>
  </DEAL>
</DEALS>
</BORROWER>
</DU_WRAPPER>
```



employment and other sources, such as retirement, that you want considered to qualify...

L1. Property and Loan Information

1a. Personal Information

**Name** (First, Middle, Last, Suffix)  
 Ken N Customer JR

**Alternate Names** – List any names by which you are known or any names under which credit was previously received (First, Middle, Last, Suffix)

**Social Security Number**  
 (or Individual Taxpayer Identification Number)

**Date of Birth** (mm/dd/yyyy)  
 07 / 04 / 1966

**Community Property State**  
 Community Property State  
 At least one borrower lives in a community property state.  
 The property is in a community property state.

**Refinance Type**  
 No Cash Out  
 Limited Cash Out  
 Cash Out

**Refinance Program**  
 Full Documentation  
 Interest Rate Reduction  
 Streamlined without Appraisal  
 Other

**Energy Improvement**  
 Mortgage loan will finance energy-related improvements.  
 Property is currently subject to a lien that could take priority over the first mortgage lien, such as a clean energy lien paid for through property taxes (e.g., the Property Assessed Clean Energy program).

**Type of Credit**  
 I am applying for individual credit.  
 I am applying for joint credit. Total Number of Borrowers: 1

**Marital Status**  
 Married  
 Separated  
 Unmarried (Single)  
 Reciprocal Beneficiary Relationship

**Dependents** (not listed by another Borrower)  
 Number 0

**List Name(s) of Other Borrower(s)** (First, Middle, Last, Suffix)

**Contact Information**  
 Home Phone (818) 222 - 222 / (mm/yyyy)  
 Cell Phone ( ) - - / (mm/yyyy)  
 Work Phone ( ) - - / (mm/yyyy)  
 Email ken.c@fanniemae.com

**Property Information**  
 Condominium  
 Cooperative  
 Planned Unit Development (PUD)  
 Property is not located in a project

**For Refinance:** Title to the Property is **Currently** Held in What Name(s):

**Trust Information**  
 Title Will be Held by an Inter Vivos (Living) Trust  
 Title Will be Held by a Land Trust

**Indian Country Land Tenure**  
 Fee Simple (On a Reservation)  
 Individual Trust Land (Allotted/Restricted)  
 Tribal Trust Land (On a Reservation)  
 Tribal Trust Land (Off Reservation)  
 Alaska Native Corporation Land

**Current Address**  
 Street 10655 Birch St  
 City Burbank State CA ZIP 915021234 Country US

How Long at Current Address? 3 Years 7 Months  
 Housing  No primary housing expense  Own  Rent (\$ 3,500/month)

If at Current Address for LESS than 2 years, list Former Address  Does not apply

**Mailing Address** – if different from Current Address  Does not apply  
 Street 10655 Birch St  
 City Burbank State CA ZIP 915021234 Country US

**Terms of Loan**  
 Note Rate 4.2500 %  
 Loan Term 360 (months)

**Mortgage Lien Type**  
 First Lien  
 Subordinate Lien

**Proposed Monthly Payment for Property**

First Mortgage (P & I)	\$ 1,475.82
Subordinate Lien(s) (P & I)	\$
Homeowner's Insurance	\$ 75.00
Supplemental Property Insurance	\$
Property Taxes	\$ 165.00
Mortgage Insurance	\$ 50.00
Association/Project Dues (Condo, Co-Op, PUD)	\$ 365.00
Other	\$ 100.00
<b>TOTAL</b>	<b>\$ 2,230.82</b>

**Military Service** – Did you (or your deceased spouse) ever serve, or are you currently serving, in the United States Armed Forces?  NO  YES  
 If YES, check all that apply:  Currently serving on active duty with projected expiration date of service/tour / / (mm/yyyy)

Mortgage Loan Origination

- New Uniform Residential Loan Application (URLA) form standardizes data presentation

## Standard Eligibility Requirements - Manual Underwriting

Excludes: High LTV Refinance, HomeReady, HomeStyle Renovation, and Refi Plus

Transaction Type	Number of Units	Maximum LTV, CLTV, HCLTV	Maximum DTI ≤ 36%		Maximum DTI ≤ 45%	
			Credit Score/LTV	Minimum Reserves	Credit Score/LTV	Minimum Reserves
<b>Principal Residence</b>						
Purchase Limited Cash- Out Refinance	1 Unit	FRM/ARM: 95%	FRM/ARM: 680 if > 75% FRM: 620 if ≤ 75% ARM: 640 if ≤ 75%	0	700 if > 75% 640 if ≤ 75%	0
			660 if > 75%	6	FRM: 680 if > 75% FRM: 620 if ≤ 75% ARM: 680 if > 75%	2
	2 Units	FRM/ARM: 85%	680 if > 75% 640 if ≤ 75%	6	700 if > 75% 660 if ≤ 75%	6
					680 if > 75% 640 if ≤ 75%	12
	3-4 Units	FRM/ARM: 75%	660	6	680	6
					660	12
Cash-Out Refinance	1 Unit	FRM/ARM: 80%	680 if > 75% 660 if ≤ 75%	0	700 if > 75% 680 if ≤ 75%	0
			660 if > 75% 640 if ≤ 75%	6	680 if > 75% 660 if ≤ 75%	2

- Loan-to-Value (LTV)
- Debt-to-Income (DTI)
- Liquid Assets after Closing (Reserves)

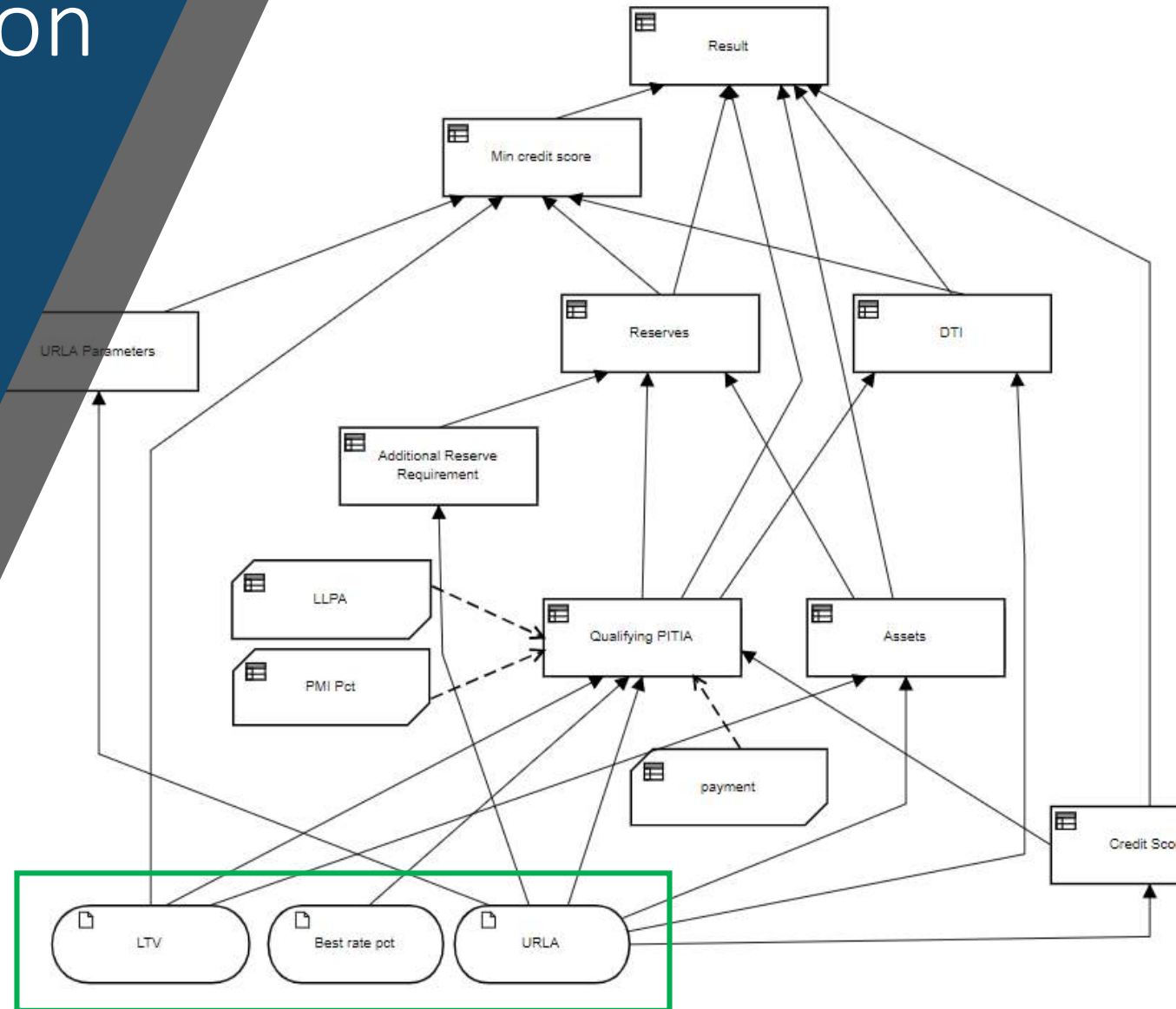
Minimum Credit Score  
Depends On...

	URLA Parameters.Usage	URLA Parameters.Transaction Type	URLA Parameters.Unit Count	URLA Parameters.Amortization Type	LTV	DTI	Reserves	Min credit score
C<	<i>ttPropertyUsage</i> "Investment", "PrimaryResidence", "SecondHome", "FHASecondaryResidence"	<i>tTransactionType</i> "Purchase", "LimitedCashoutRefinance", "CashoutRefinance"	<i>Number</i>	<i>tAmortizationTypeType</i> "Fixed", "AdjustableRate", "Other"	<i>tPercent</i>	<i>tPercent</i>	<i>Number</i>	<i>Number</i>
1	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	"Fixed"	<=75	<=36	>0	620
2	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	"Fixed"	<=75	(36..45]	>=2	620
3	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	"AdjustableRate"	<=75	<=36	>0	640
4	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	-	<=75	(36..45]	>0	640
5	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	-	(75..95]	<=36	>=6	660
6	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	-	(75..95]	<=36	(0..6)	680
7	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	-	(75..95]	(36..45]	>=2	680
8	"PrimaryResidence"	"Purchase","LimitedCashoutRefinance"	1	-	(75..95]	(36..45]	(0..2)	700

Min credit score as a DMN Decision Table

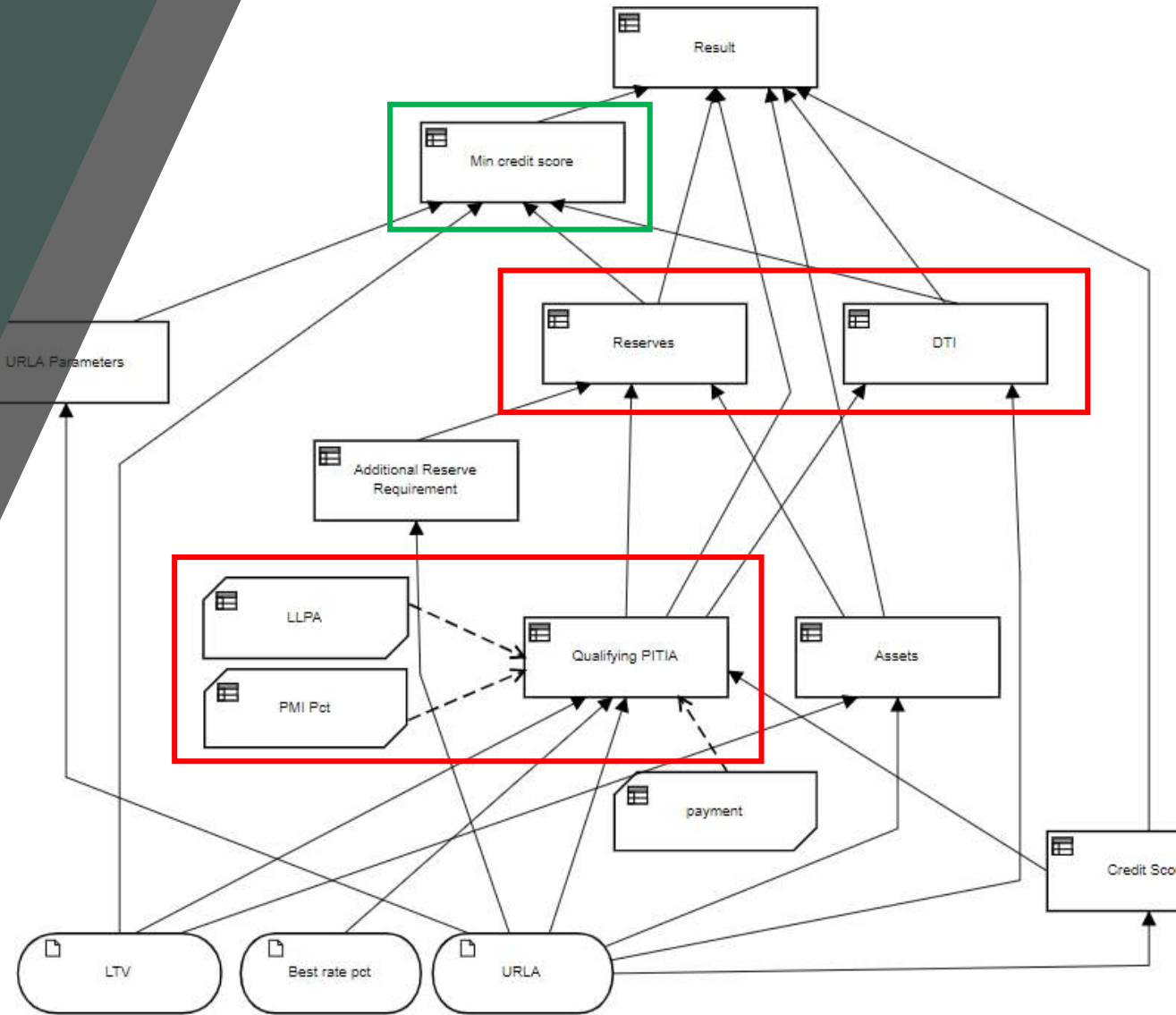
# The Underwriting Decision

- *URLA* specifies Borrower income, debt payments, assets, property value, credit score
- *Best rate pct* is current loan rate for best credit score, lowest LTV
- Try different values of Loan amount (*LTV*)

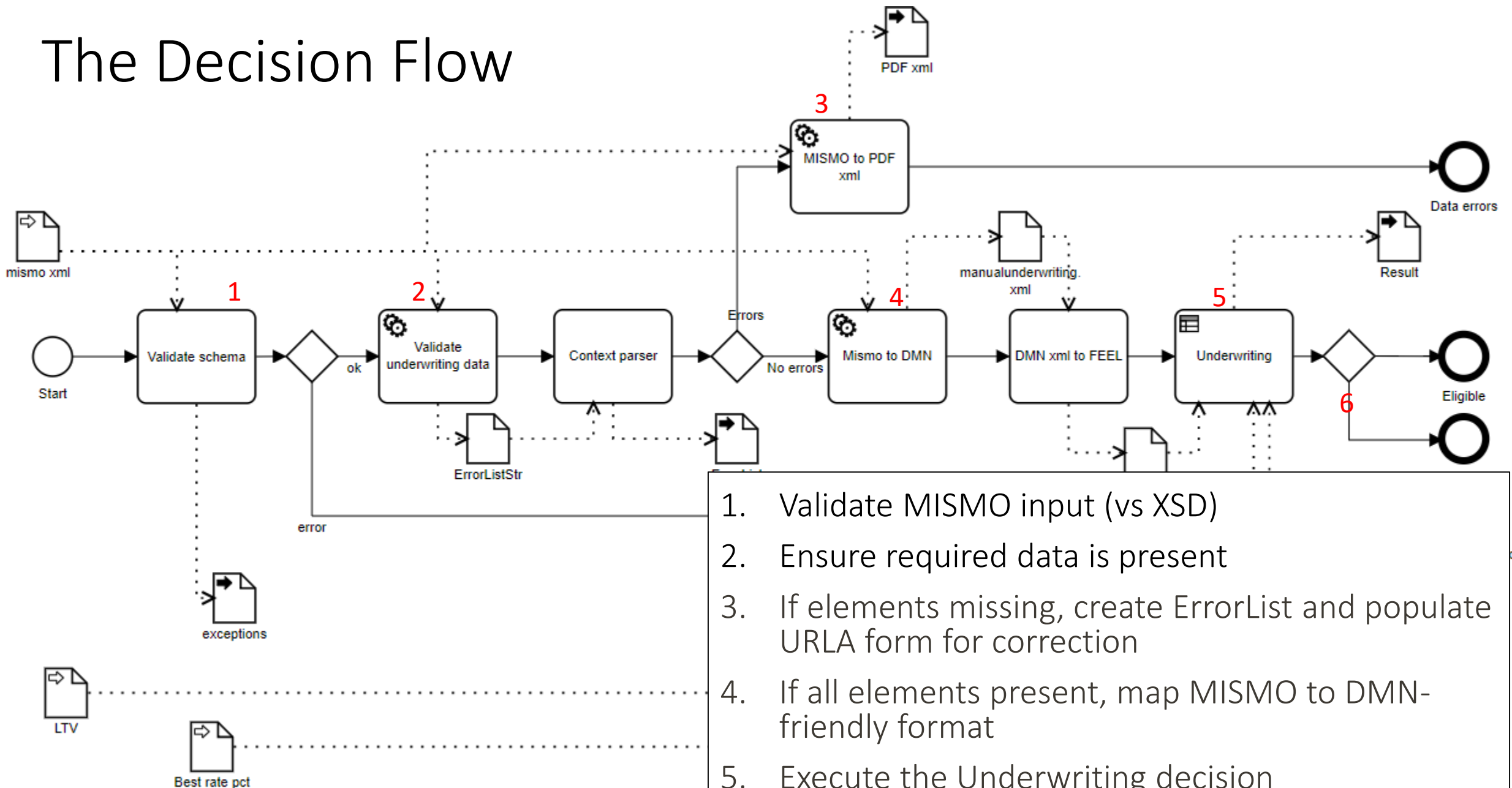


# The Hard Part

- *LTV + Credit Score affects Adjusted Loan Rate (LLPA)*
- *LTV > 80% requires Private Mortgage Insurance (PMI)*
- *Adjusted Loan Rate and PMI affect DTI*
- *LTV determines Down Payment, which affects Assets After Closing (Reserves)*



# The Decision Flow



1. Validate MISMO input (vs XSD)
2. Ensure required data is present
3. If elements missing, create ErrorList and populate URLA form for correction
4. If all elements present, map MISMO to DMN-friendly format
5. Execute the Underwriting decision
6. Branch on outcome

# DMN-Friendly Data

- Example: Borrower1's Credit Score

- MISMO

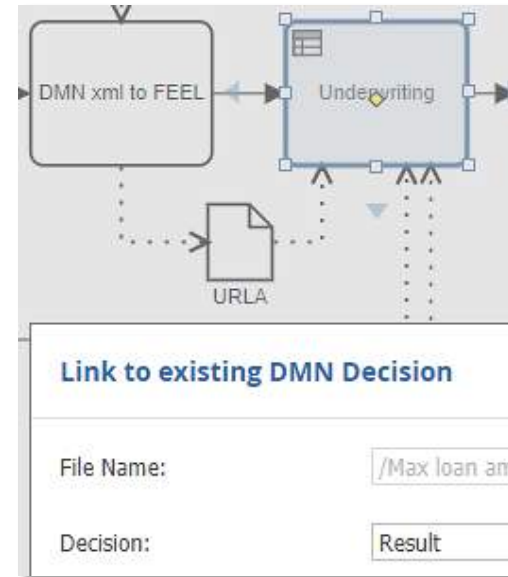
```
MESSAGE.DEAL_SETS.DEAL_SET.DEALS.DEAL.PARTIES.PARTY  
[ROLES.ROLE.ROLE_DETAIL.PartyRoleType ="Borrower"]  
[1].ROLES.ROLE.BORROWER.CREDIT_SCORES.CREDIT_SCORE.  
CREDIT_SCORE_DETAIL.CreditScoreValue
```

- DMN-Friendly Format

```
Borrower1.Credit Score
```

# Modeling Decision Tasks

1. Link to a DMN model/decision
2. Map data object/input to input data
3. Map decision output to data object/output
4. Test output in a gateway



## Data Input Mapping

The inputs cannot be modified since they are p

LTV <i>Max loan amount.tPercent</i>	LTV
URLA <i>Max loan amount.URLA</i>	URLA
Best rate pct <i>Max loan amount.tPercent</i>	Best rate pct

## Data Output Mapping



## Gateway Mapping

### Sequence Flow Condition Details

#### Condition Expression:

Result.Eligibility="Eligible"



# Modeling Service Tasks

1. Import service to Operation Library via OpenAPI file
2. Bind task to a service operation
3. Invocation mapping
  - Data objects/inputs to service inputs
  - Service outputs to data objects/outputs

**Operation Library**

Q Search Element

- ▶ MISMO to PDF Service
- ▶ MISMO to DMN Underwriting Service
- ▶ Max loan amount
- ▶ Validate underwriting data

Import OpenAPI

**Data Output Mapping**

1	ErrorListStr Text	Execution result.results.error list xml
2	errorList3 Text	Execution result.results.error list xml

**Validate underwriting data**

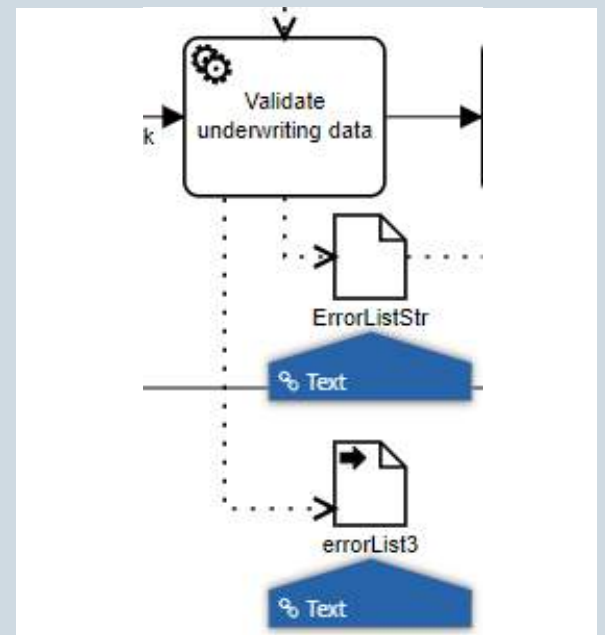
**Service details**

**Interface:**

Validate underwriting data

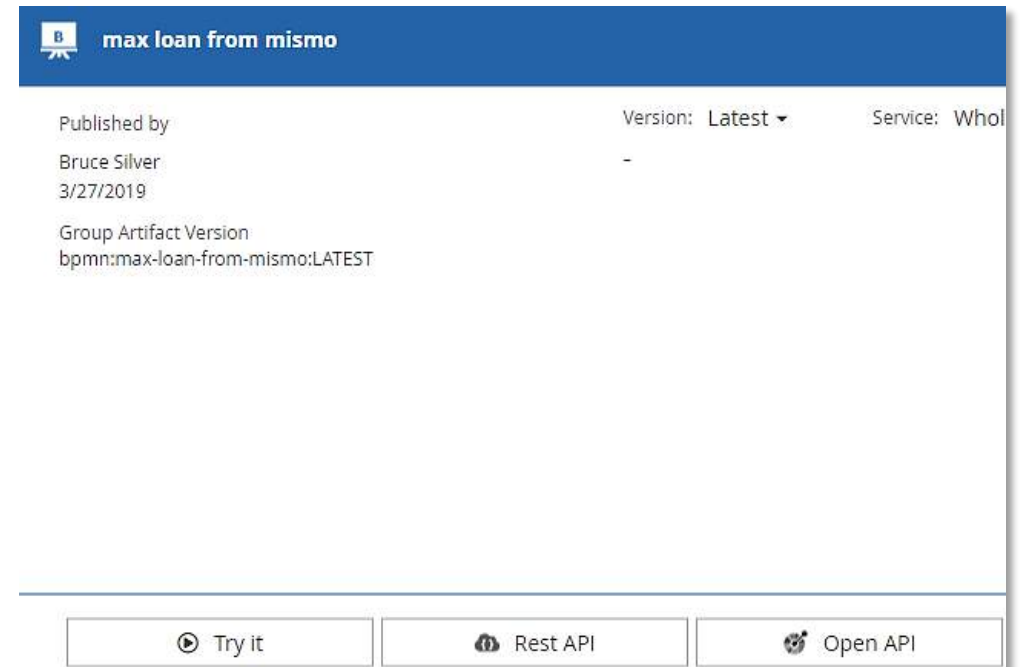
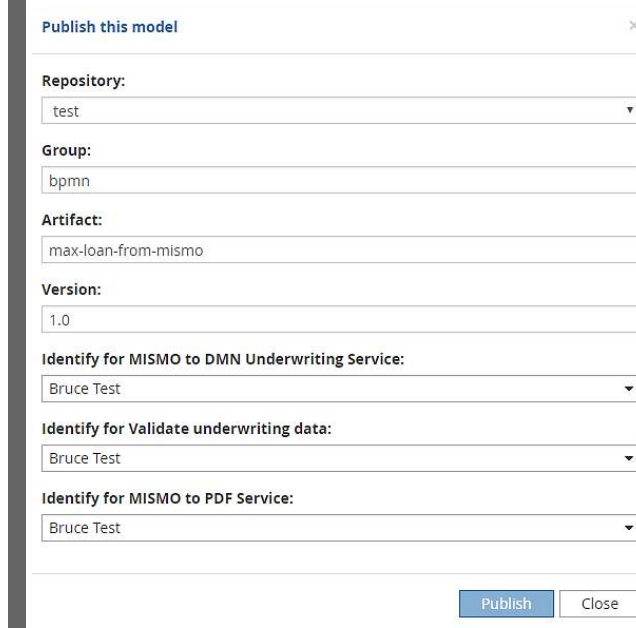
**Operation:**

Execute Validate underwriting data



# One-Click Publish and Deploy

1. Click Cloud Publish
2. Specify Client App Identity for service invocations
3. From Service Library can
  1. Test the service
  2. Download OpenAPI file for external invocation



# Test the Deployed Process

- Enter input data values
- Can mix XML and FEEL inputs
- All components of BPMN data outputs returned

## max loan from mismo

Best rate pct

4.0

LTV

80

mismo xml

ken customer ll\_mismo.xml

Run

## Results

exceptions ErrorList PDF xml **Result** end

<b>Eligibility</b>	Eligible
<b>Loan amount</b>	272,000
<b>Credit score</b>	660
<b>Min credit score</b>	660
<b>Loan rate</b>	4.375
<b>Mortgage payment</b>	1,358.06
<b>PMI payment</b>	0
<b>PMI</b>	0.000000

# Artifacts for the Mortgage Industry

- Interactive URLA form (PDF)
  - XML Import/Export
- Utility Services
  - Mapping from MISMO to URLA PDF
  - Mapping from URLA PDF to MISMO
  - Mapping from MISMO to DMN-friendly FEEL
  - Validate data completeness for manual underwriting
  - Validate data completeness for submission to FNMA
- Modifiable examples
  - Loan Underwriting (DMN)
  - Data validation, mapping, underwriting (BPMN)