Decision Tables

Process Logic
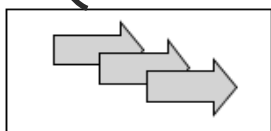
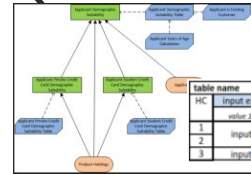**Business Logic**

KIT

KIT
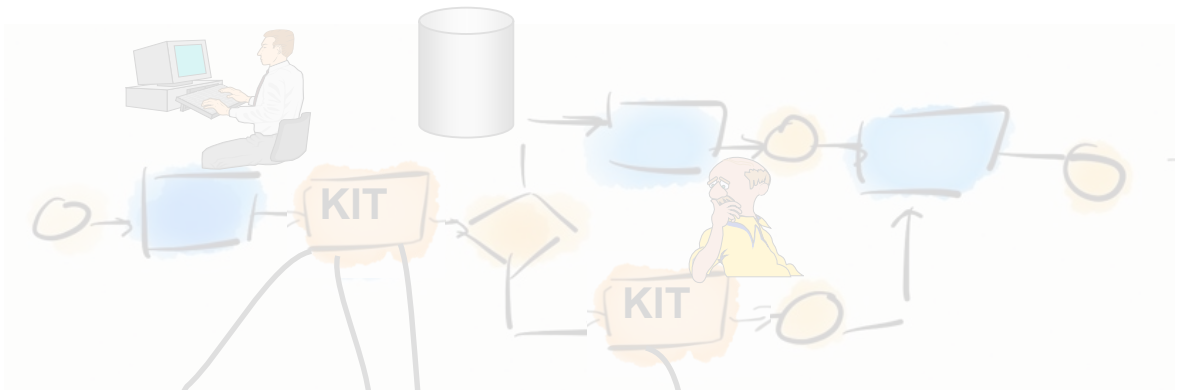
text

rules

decision model

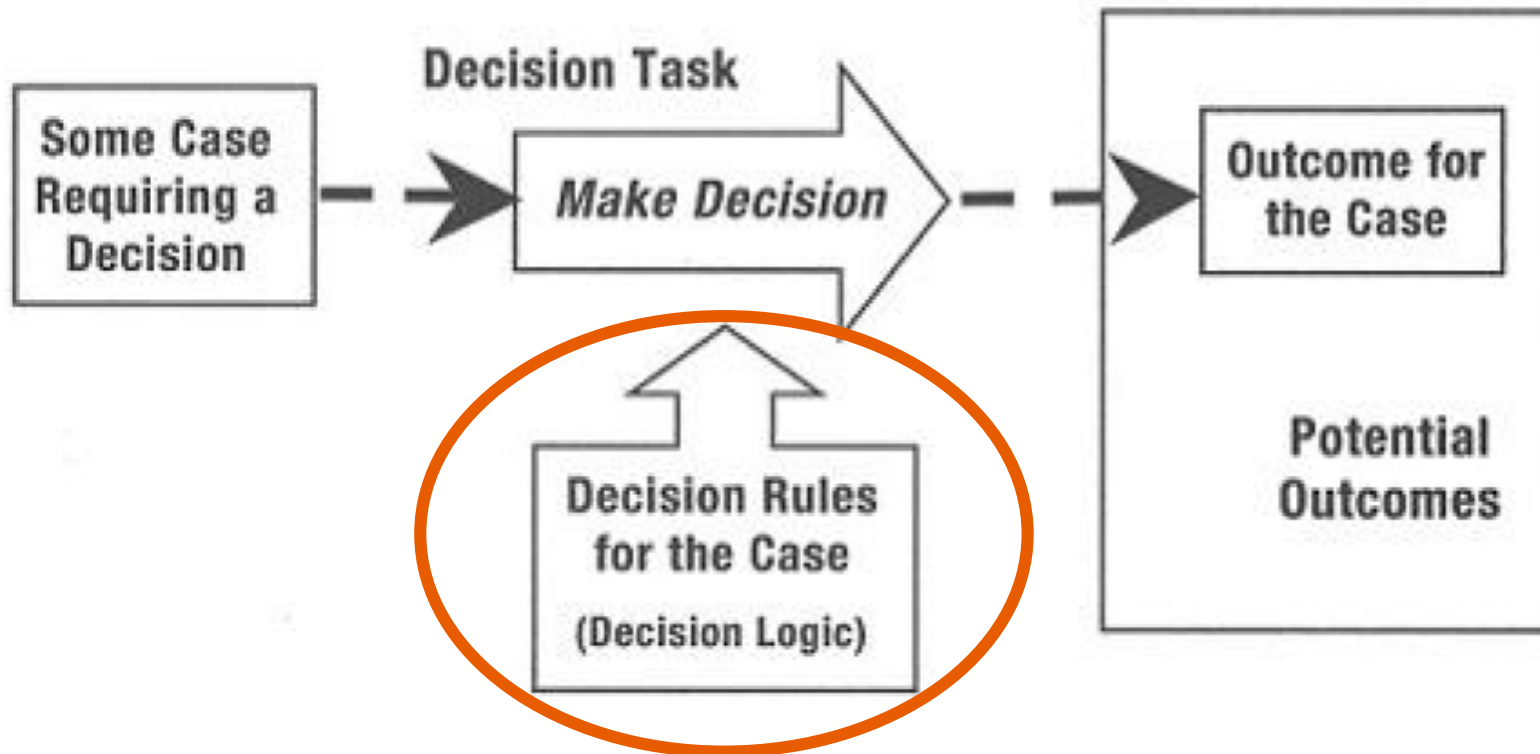| table name			
HC	input expression 1	input expression 2	Output name
	value 1a, value 1b	value 2a, value 2b	value 1a, value 1b
1	input entry 1a	input entry 2a	output entry 1a
2		input entry 2b	output entry 1b
3	input entry 1b	-	output entry 1a

human experts

Decision Model and Notation

Beta1

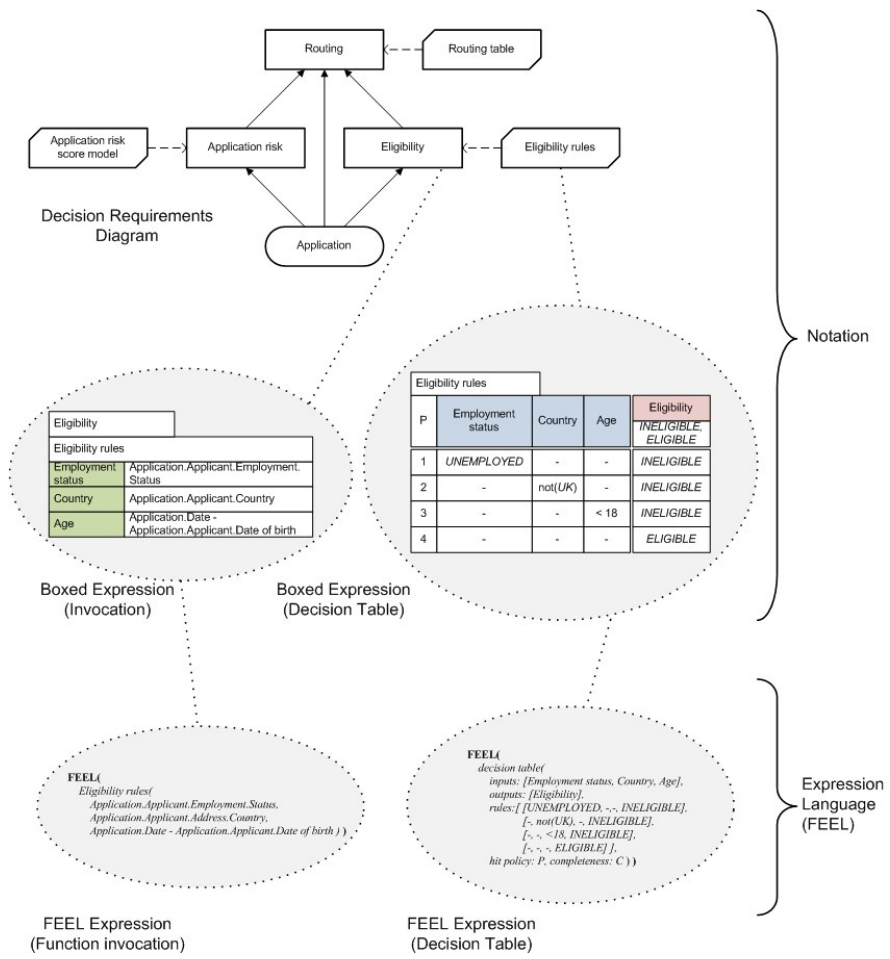# DECISION MODEL AND NOTATION (DMN)

Decision Logic and Decision Task

Decision Task

Some Case Requiring a Decision → Make Decision → Outcome for the Case

Decision Rules for the Case (Decision Logic)

Potential Outcomes

(Ross 2011, p. 152f)

Decision Model and Notation (DMN)

- The Decision Model and Notation is a new standard from the OMG

- It is currently published in its version 1.2

- Purpose of DMN: provide the constructs that are needed to model decision, so that organizational decision-making can be
  - readily depicted in diagrams
  - accurately defined by business analysts
  - (optionaly) automated

Main Concepts of DMN

More details

| Business Process |
| Decision Requirements |
| Decision Logic |
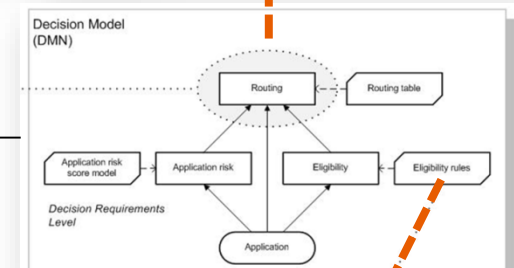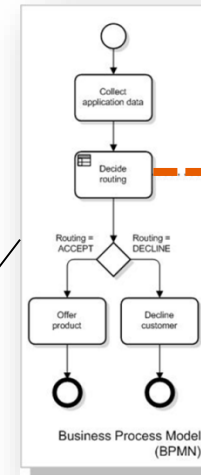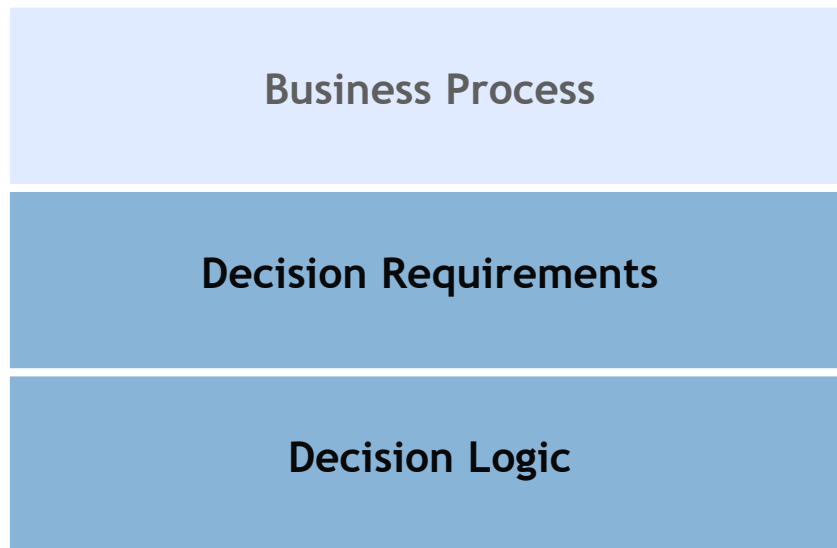
(Coenen 2013)

Main concepts – Decision Requirements Level

- Business concepts only

- Business decisions

- Areas of business knowledge

- Sources of business knowledge

Decision Requirements

(Coenen 2013)

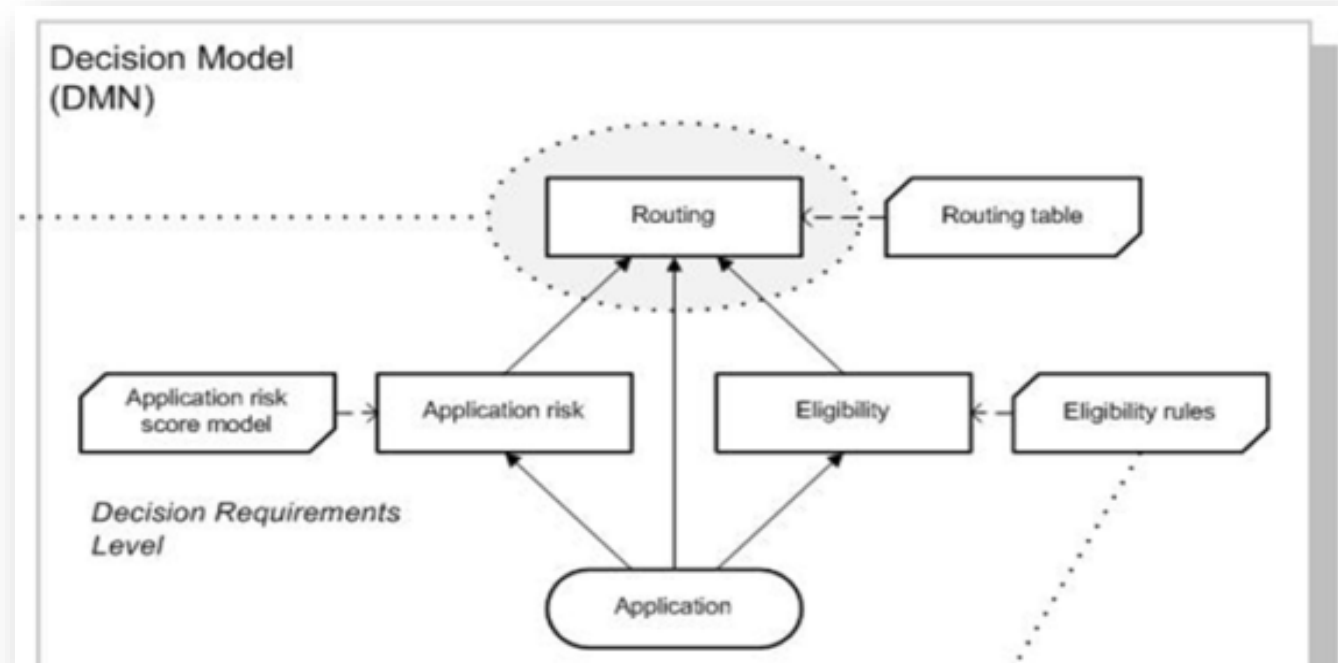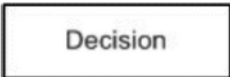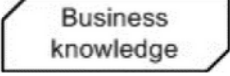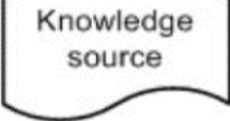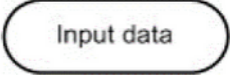# Constructs of a Decision Requirements Model

Construct	DMN Notation	Description
ELEMENTS		
Decision	Decision	The act of determining an output from a number of inputs, using decision logic which may reference one or more business knowledge models.
Business Knowledge Model	Business knowledge	A function encapsulating business knowledge, in the form of business rules, decision table or analytic model. Some of the tool may not support this element. In such case the decision logic is directly linked to the Decision rather than the business knowledge model.
Knowledge Source	Knowledge source	The authority for a business knowledge model or decision.
Input Data	Input data	Information used as an input by one or more decisions. It also denotes the parameters of a Business Knowledge Model.
REQUIREMENTS		
Information Requirement	→	Information – input data or decision output – required for a decision.
Knowledge Requirement	⇢	The invocation of a business knowledge model.
Authority Requirement	⇢•	Showing the knowledge source of an element or the dependency of a knowledge source on input data.
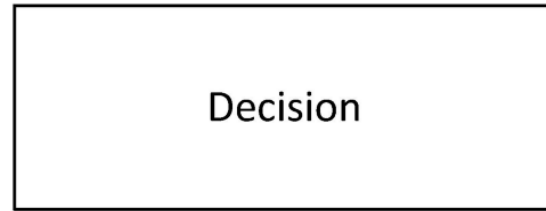
Decision

Decision

- A decision determines an output from a number of inputs by applying some decision logic.

- Two properties should be captured for every decision:
    - Question: A specific and detailednatural language statement that represents the decision in the form of a question.
    - Allowed Answers: A natural language description of the potential outcomes.

- Decisions can have reference to Decision Logic

- Decisions can be decomposed into sub-decisions.
    - Top level decisions can be thought of as selecting an answer from a range of possible answers.
    - Lower level decisions provide input to higher-level decisions.

Business Knowledge Models

Business Knowledge

- Business knowledge models represent reusable decision logic.

- The decision logic might be
  - a decision table,
  - a decision tree,
  - a set of business rules,
  - an analytic model.
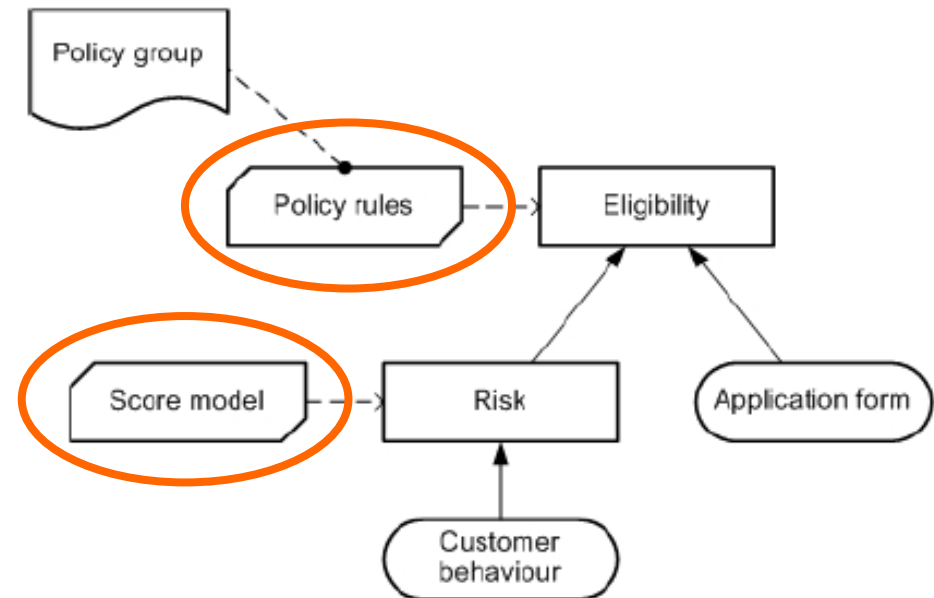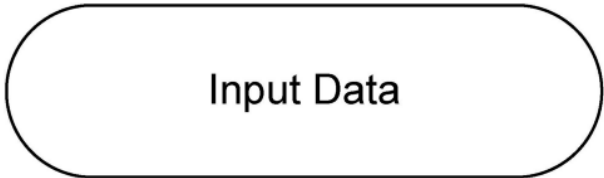
Input Data

Input Data

- Decisions require are input data.

- Input data elements typically represent business entities that are being used in the decision making, such as Application Form or Customer Data.
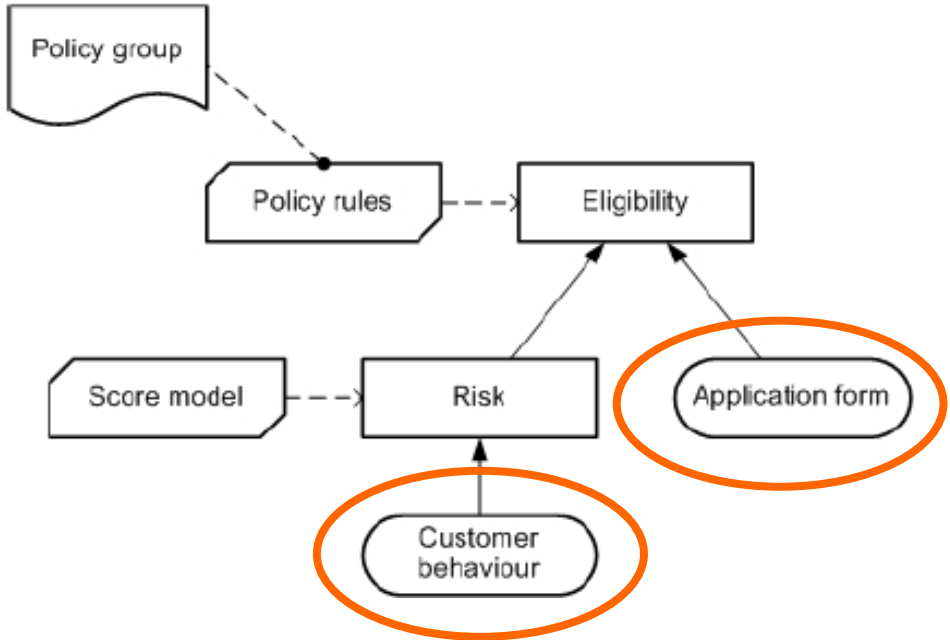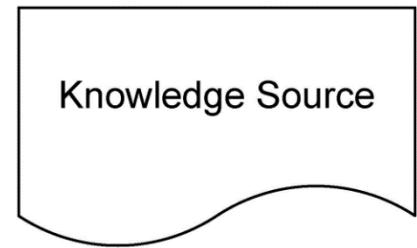
Knowledge Source

■ Knowledge sources represent the source of know-how for making a decision. This could be regulations or policies, best practices or expertise on how a decision should be made.

■ Knowledge sources are the authorities for a decision and typically refer to some external document or source that contains detailed guidance
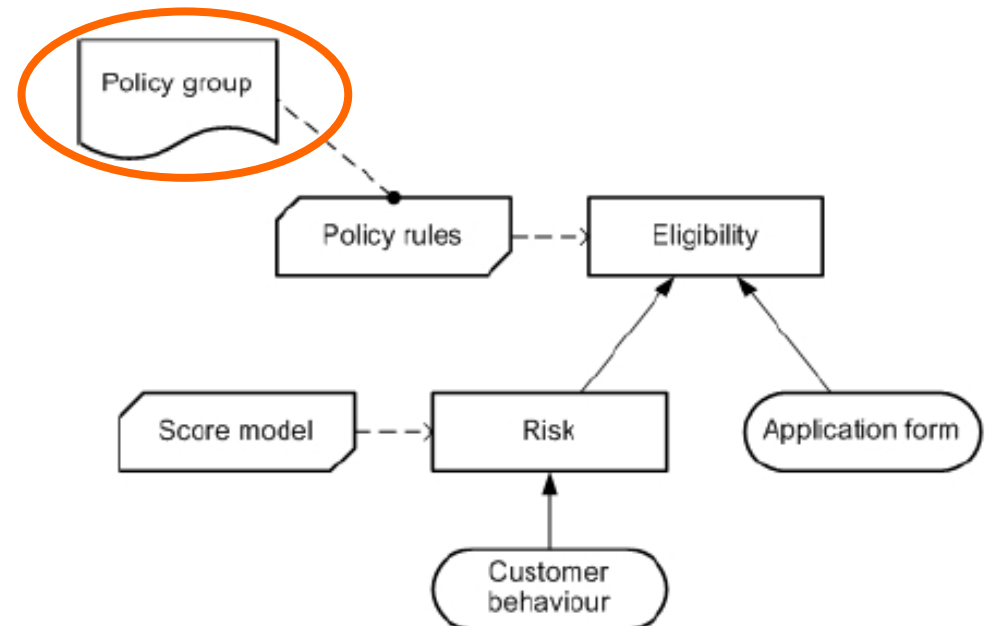
DRD Requirements

Shows that Input Data or Decision output is required as an input by another Decision

Shows that a Business Knowledge Model is invoked by a Decision or another Business Knowledge Model

Shows the dependency of a DRD Element on a Knowledge Source
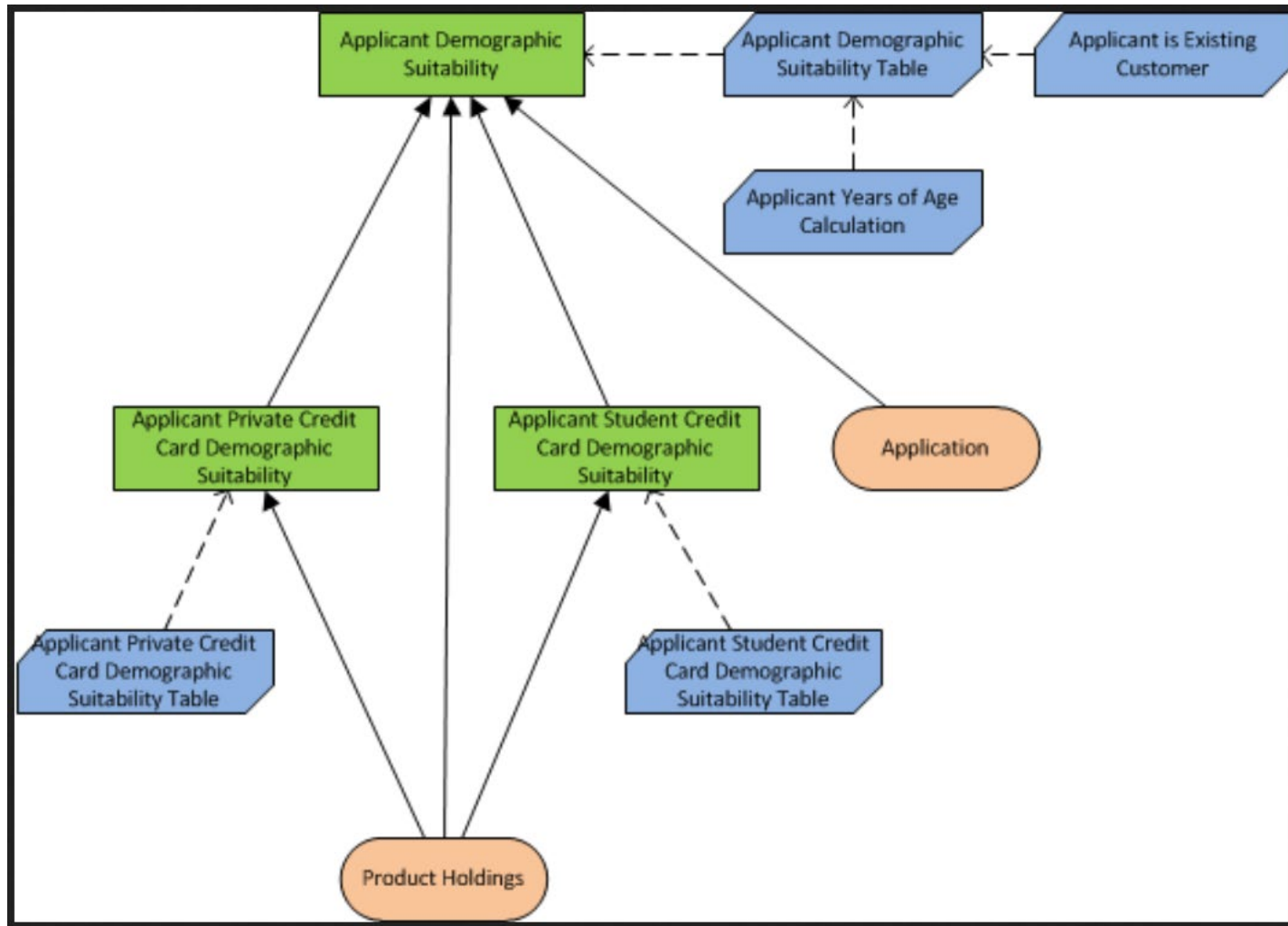
Main concepts – Decision Logic

- Greater detail

- Business rules

- Calculations

- Automated

- Display

(Coenen 2013)

Decision Tables

"I'm here because my boss said we should use more decisions tables for our project. What types of decision tables do you sell?"

Structure of a Decision Table in DMN

Hit policy

Completeness indicator

Name of Decision Table

Set of Inputs

Output(s)
Multiple output columns allowed

Decision name			
HC	Input expression 1	Input expression 2	Output name
	value 1a, value 1b	value 2a, value 2b	value 3a, value 3b
1	value 1a	value 2a	value 3a
2	value 1b	value 2b	value 3b

Rule number

Lists of expected values (optional)

Double line between inputs section and outputs section, and between inputs/outputs headers and the rule entry cells.

Decision Tables

Employee appropriateness score

C	Region of employee = Region of customer	Claims Expenditure (estimated)	Experience of employee	Number of open claims of employee	Score
	yes/no	Number	low/medium/high	Number	Number
1	yes				100
2		[1000..10000]	low		-100
3		>10000	low		-1000
4		>10000	medium		-100
5				[10..20]	-100
6				[20..30]	-500
7				>30	-1000
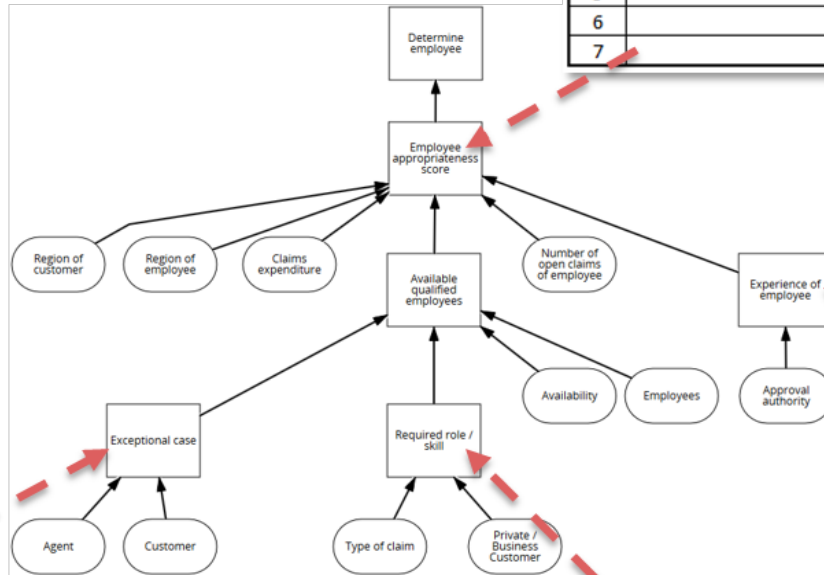
Experience of Employee

	Approval Authority	Experience
1	<1000	low
2	[1000..10000]	medium
3	>10000	high

Exceptional Case

	Agent Id	Customer Frame Contract Id	Required Role	Special Employee
1	4711		Special Customer Task Force Berlin	
2		0815	Special Customer Task Force Berlin	
3		camunda		Mr. Important
4	...	...	...	...

Required Skill / Role

	Type of Claim	Private/Business Customer?	Required Role	Required Skill
1	Third Party Liability	Private	Service Center	
2	Third Party Liability	Business	Service Center	Business Law Qualification
3	Accident	Private	Service Center	
4	Accident	Business	Business Accident Team	
5	...	...	...	

Decision Tables – Reducing Combinations

■ If effects for several combinations are the same, the combinations can be combined, reducing the number of rules

■ Example:

 ◆ If Cause 1 is „yes", the effect does not depend on the value of Cause 2

 ◆ In this case, the value of Cause 2 does not need to be taken into account

effect			
	Cause1	Cause 2	Effect
	yes, no	*yes, no*	*E1, E2, E3*
1	yes	yes	E1
2	yes	no	E1
3	no	yes	E2
4	no	no	E3

effect			
	Cause1	Cause 2	Effect
	yes, no	*yes, no*	*true, false*
1	yes	-	E1
2	no	yes	E2
3	no	no	E3

Exercise: Reduce decision table

- The following decision table represents rules for reimbursing expenses by health insurance

- Reimbursement depends on three conditions:
  - whether decuctible is already met,
  - whether the patient visited the doctor's office (D), a hospital (H) or a lab (L) and
  - whether – in case of a visit at the doctor's office – the physician is present

- The decision table is complete showing all combinations of decisions. Reduce the table to only the really needed number of rules

Reimbursement

	Deductable met	Type of visit	Physician present	Reimbursement
	yes, no	*D, H, L*	*yes, no*	*integer*
1	yes	D	yes	90
2	yes	D	no	50
3	yes	H	yes	80
4	yes	H	no	80
5	yes	L	yes	70
6	yes	L	no	70
7	no	D	yes	0
8	no	D	no	0
9	no	H	yes	0
10	no	H	no	0
11	no	L	yes	0
12	no	L	no	0

Decision Tables

Reduced Decision Table for Health Insurance

Reimbursement depends on whether decuctible is already met, whether the patient visited the doctor's office (D), a hospital (H) or a lab (L) and whether the Doctor in the doctor's office is a Participating Physician

Reimbursement			
	Deductable met	Type of visit	Physician present	Reimbursement
	yes, no	D, H, L	yes, no	integer
1	yes	D	yes	90
2	yes	D	no	50
3	yes	H	-	80
4	yes	L	-	70
5	no	-	-	0

- A Hospital visit and a Lab visit have the same reimbursement, independent of a participating physician.

- If the deductible is not met, no reimbursement is given, independent of the other conditions

http://web.sxu.edu/rogers/sys/decision_tables.html

Subdecisions:
Result of one decision is input to another decision

Decision Requirements Diagram
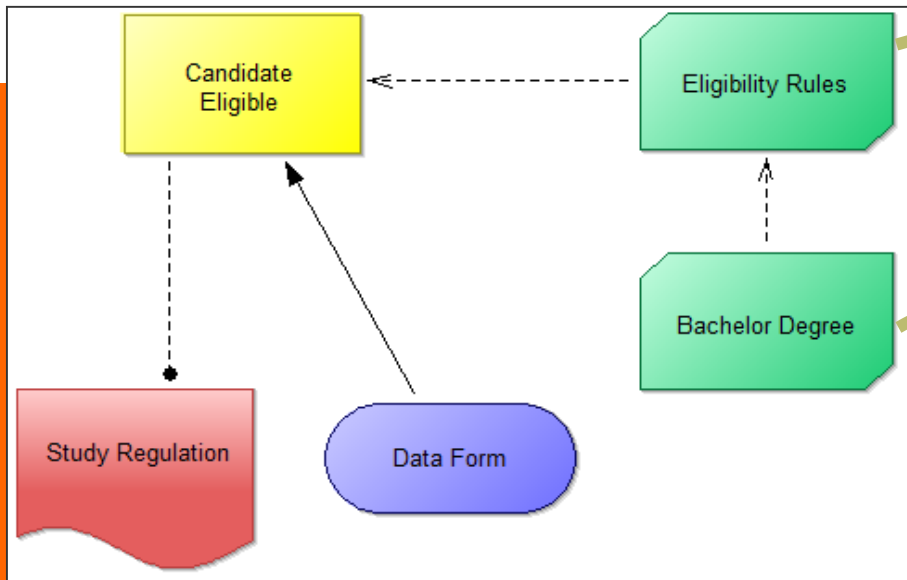
Decision Tables

Eligibility

A	Degree valid	University Registered	eligible
	yes,no	yes, no, unclear	yes,no
1	yes	yes	yes
2	no	-	no
3	-	no	no
4	-	unclear	no

Degree valid

A	Bachelor Degree	Degree valid
	IS, BA, IT, other	yes,no
1	IS	yes
2	BA	yes
3	IT	yes
4	other	no

Hit Policies (1)

- The hit policy specifies what the result of the decision table is, if there are multiple matches for a given set of inputs.

- The hit policy indication is mandatory and is summarized using a single character in a particular decision table cell.

Single Hit Policies:

Hit Policy	Description
Unique	This is the default policy. All rules are exclusive and only a single rule is matched.
Any	Multiple matching rules, all matching rules with the same output. Any of these outputs can be used.
Priority	Multiple matching rules with different outputs. Returns the matching rule with the highest output priority which is specified in an ordered list of values, e.g. the list of expected output values.
First	Multiple matching rules with different outputs. First hit by rule order is returned. Once there is a hit, the evaluation stops (and ignore the rest of the rules). The matching has a dependency on the order of the rules. The last rule is often the *catch-remainder* rule. **This type of policy is hard to validate manually and must be used with care.**

Hit Policies (2)

Multiple Hits Policies for Single Output

Hit Policy	Description
No order	Returns all hits in a unique list in arbitrary order.
Output order	Returns all hits in decreasing priority order. Output priorities are specified in an ordered list of values.
Rule order	Returns all hits in rule order, i.e. dependency on the order of the rules.

Aggregation for Multiple Hits Policy

Aggregation	Description
Collect	The result of the decision table is the list of all the outputs, ordered or unordered per the hit policy.
Sum	The result of the decision table is the sum of all the outputs.
Min	The result of the decision table is the smallest value of all the outputs.
Max	The result of the decision table is the largest value of all the outputs.
Count	The result of the decision table is the number of outputs.
Average	The result of the decision table is the average value of all the outputs, defined as the sum divided by the count.

Orientation of Rules in a DMN Decision Table

Rules as Rows:

table name			
HC	input expression 1	input expression 2	Output name
	value 1a, value 1b	*value 2a, value 2b*	*value 1a, value 1b*
1	input entry 1a	input entry 2a	output entry 1a
2		input entry 2b	output entry 1b
3	input entry 1b	-	output entry 1a

Rules as Columns:

| table name				
input expression 1	*value 1a, value 1b*	input entry 1a		input entry 1b
input expression 2	*value 2a, value 2b*	input entry 2a	input entry 2b	-
Output name	*value 1a, value 1b*	output entry 1a	output entry 1b	output entry 1a
HC		1	2	3

Rules as Crosstabs:

table name			input expression 1	
Output name			input entry 1a	input entry 1b
input expression 2	input entry 2a		output entry 1a	output entry 1a
	input entry 2b		output entry 1b	output entry 1a

FEEL = Friendly Enough Expression Language

FEEL is a script language for decision tables
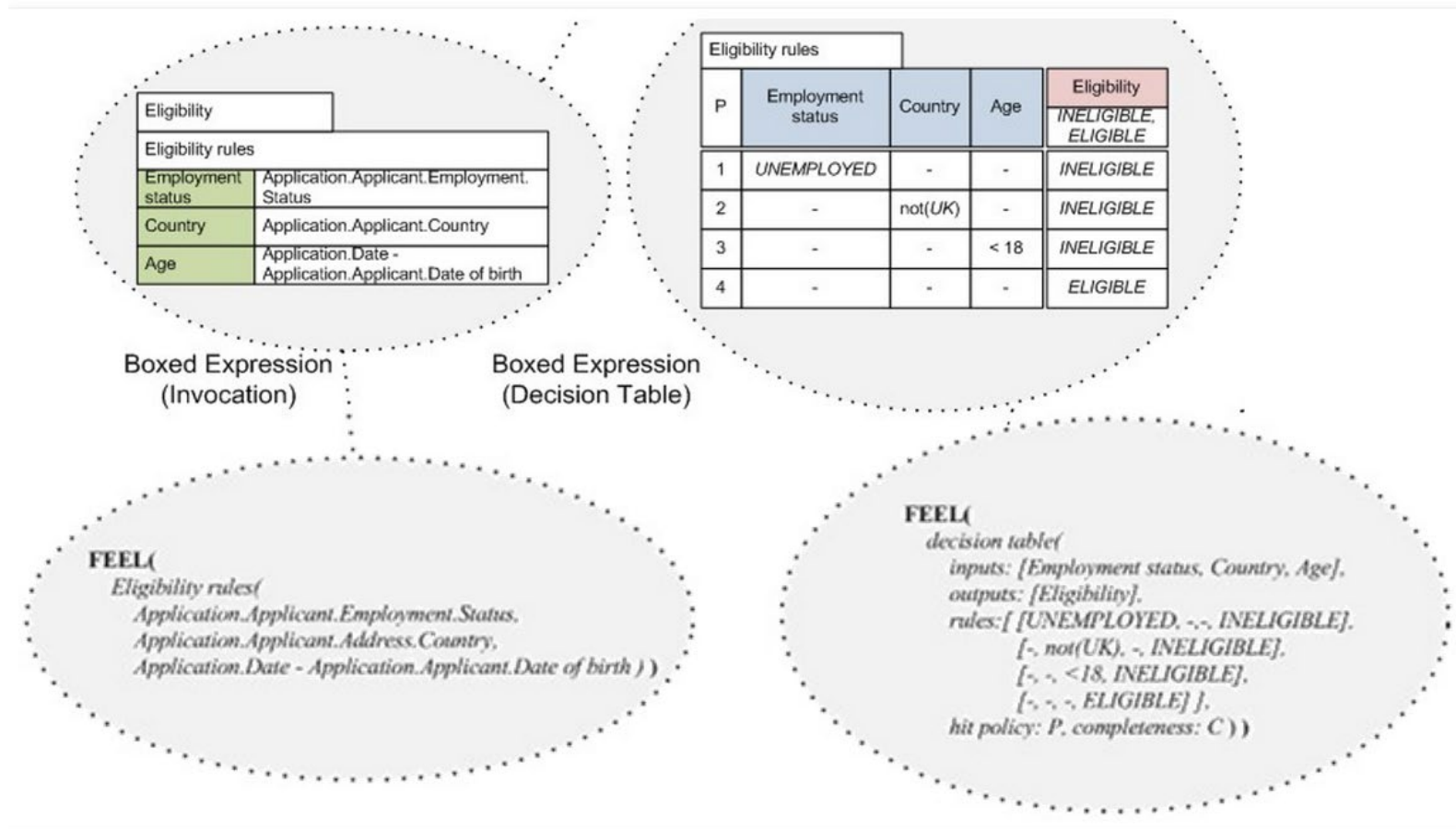
Literatur

- Ross, R. G., & Lam, G. S. W. (2011). *Building Business Solutions: Business Analysis with Business Rules*. Business Rule Solutions Inc.

- Alcedo Coenen (2013). Decision Model & Notation (DMN) 1.0 – a new OMG Standard. http://de.slideshare.net/alcedocoenen/intro-dmn-10

- OMG (2014). Decision Model and Notation, Beta 1, http://www.omg.org/spec/DMN/

- Von Halle, B., & Goldberg, L. (2010). *The Decision Model: A Business Logic Framework Linking Business and Technology*. CRC Press Auerbach Publications.