



IC3K 2015

7th International Joint Conference on Knowledge Discovery,
Knowledge Engineering and Knowledge Management

Lisbon, Portugal
12 -14 November, 2015

* Keynote

Smart data, decisions and processes

Jan Vanthienen

KU Leuven (Belgium)
Leuven Institute for Research
in Information Systems
jan.vanthienen@kuleuven.be



Research and teaching:

Data & Process analytics
Business rules, processes and information
Decision models and tables
Smart Business

* Business Process Modeling

* To visualize/improve the Business

- * Document agreement on what the Business wants to accomplish
- * Remove ambiguity
- * Enable the “Big Picture” view of the Business

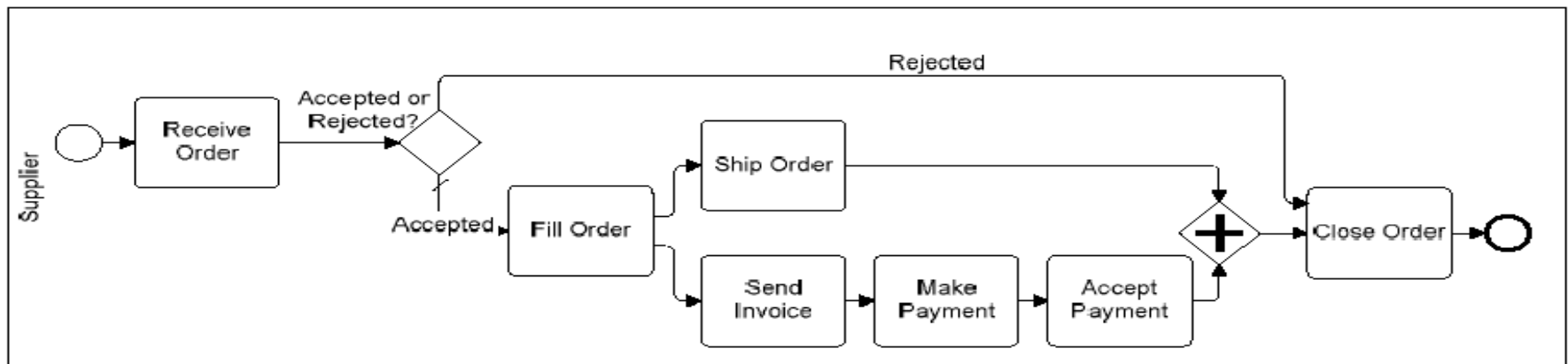
* To automate the Business

- * Driving software development with models
- * Creating software directly from models



* Business Process Modeling

A business process model is a collection of related, structured activities that produce a specific service or product (serve a particular goal)



Objectives: (1) descriptive, (2) prescriptive, (3) explanatory

*Overview



• Business process concerns

• Decisions and processes

• Decision model & notation

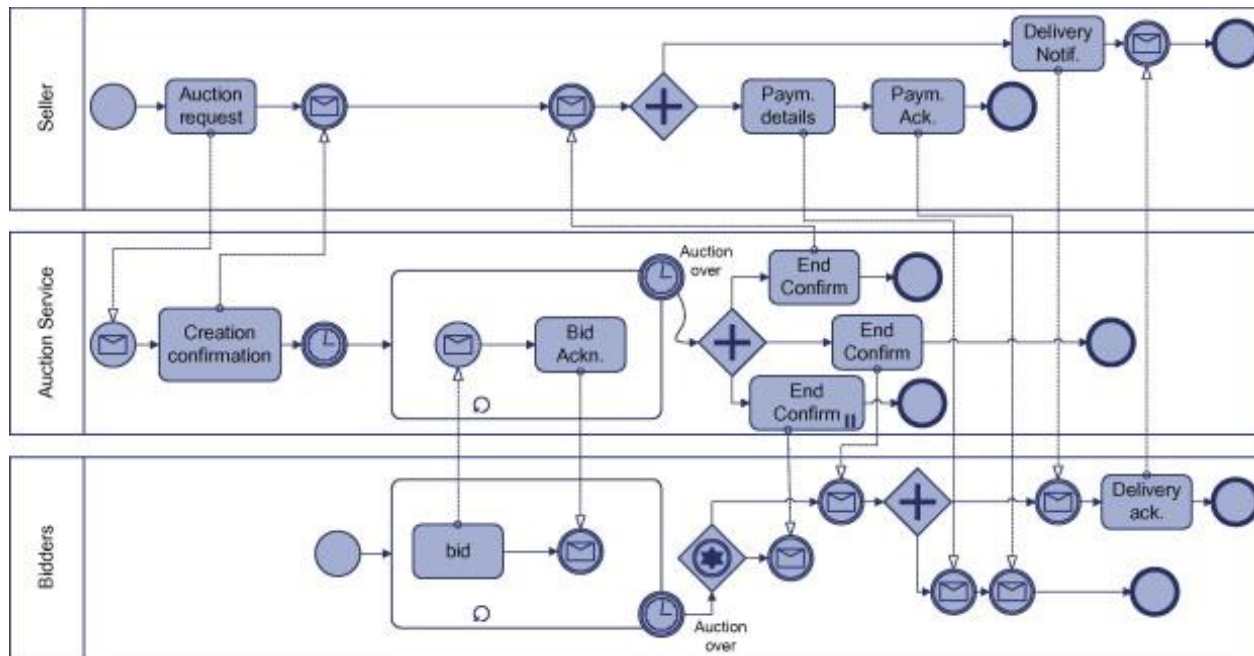
• Decision tables

• Decision processes



Business process concerns

* What should be in the process model?

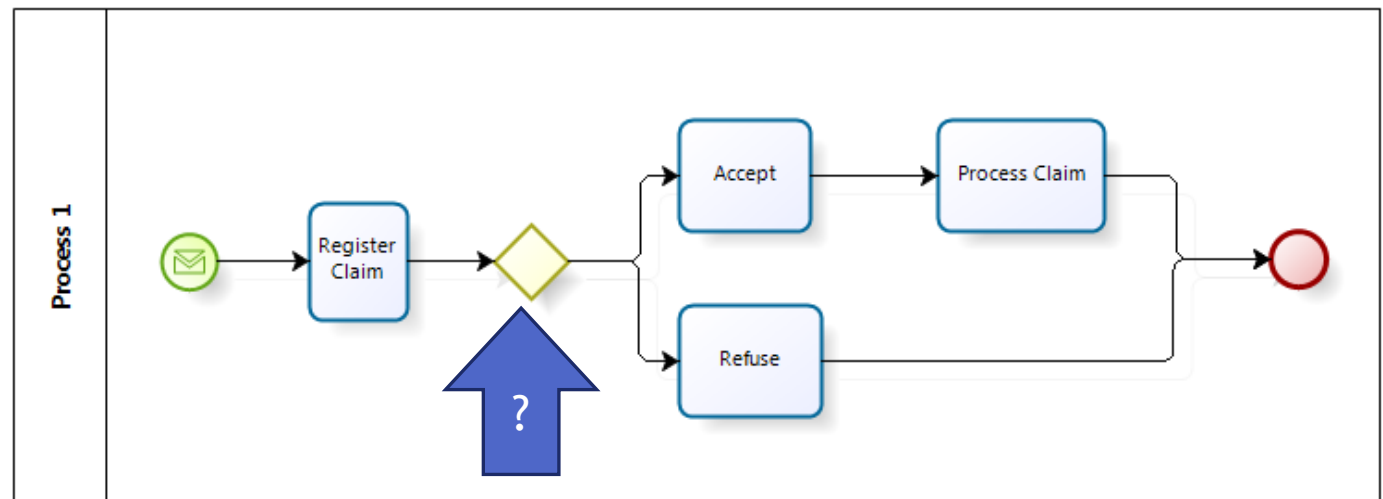


- Exceptions?
- Timers?
- Happy path?
- Decisions?
- Decision logic?
- Roles?
- Messages?
- Notifications?
- Triggers?
- Conditions?
- ...

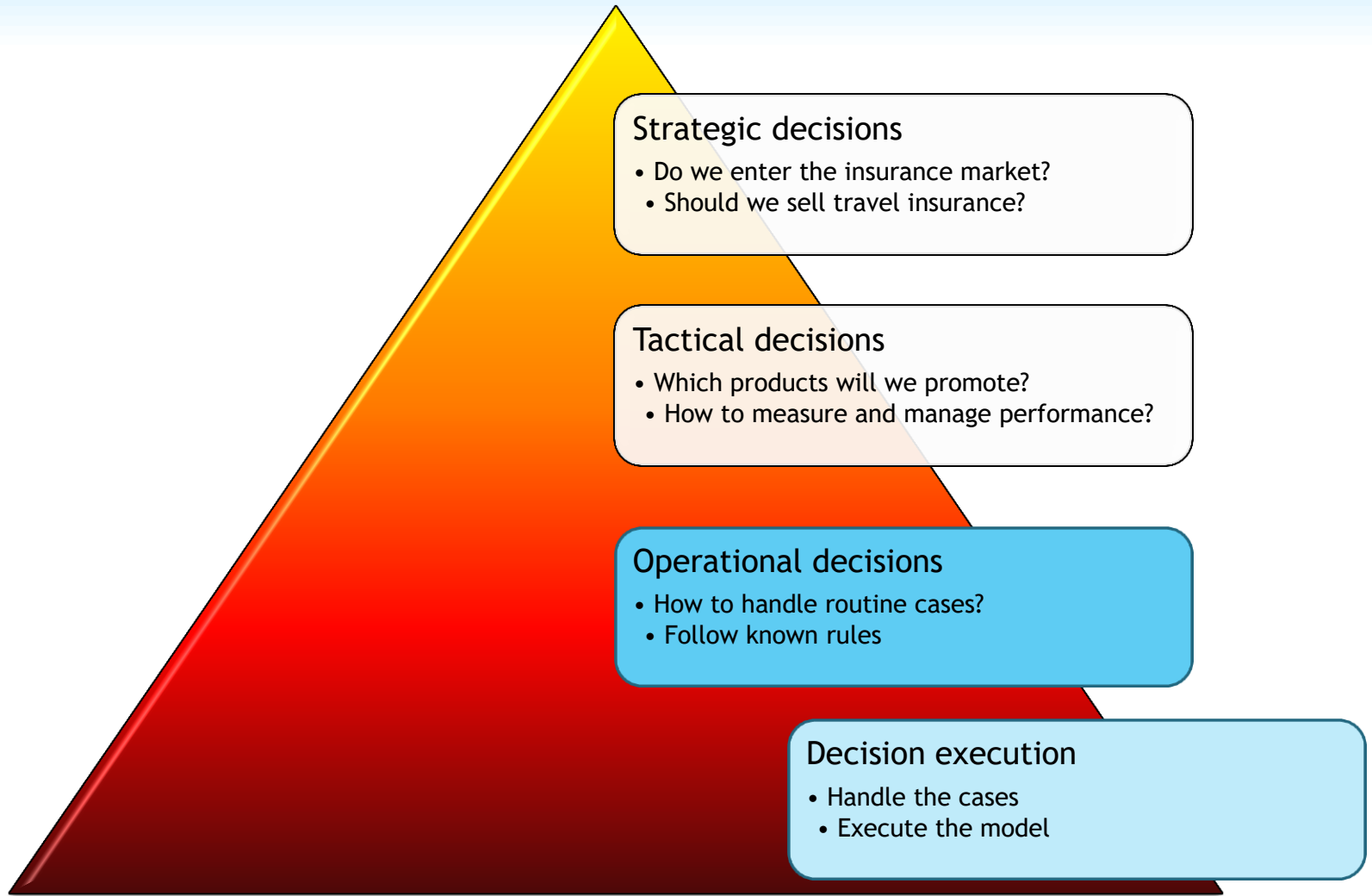
* Observation 1: what to model?

Decisions are important for business, not only processes.
Why would we only model the processes?

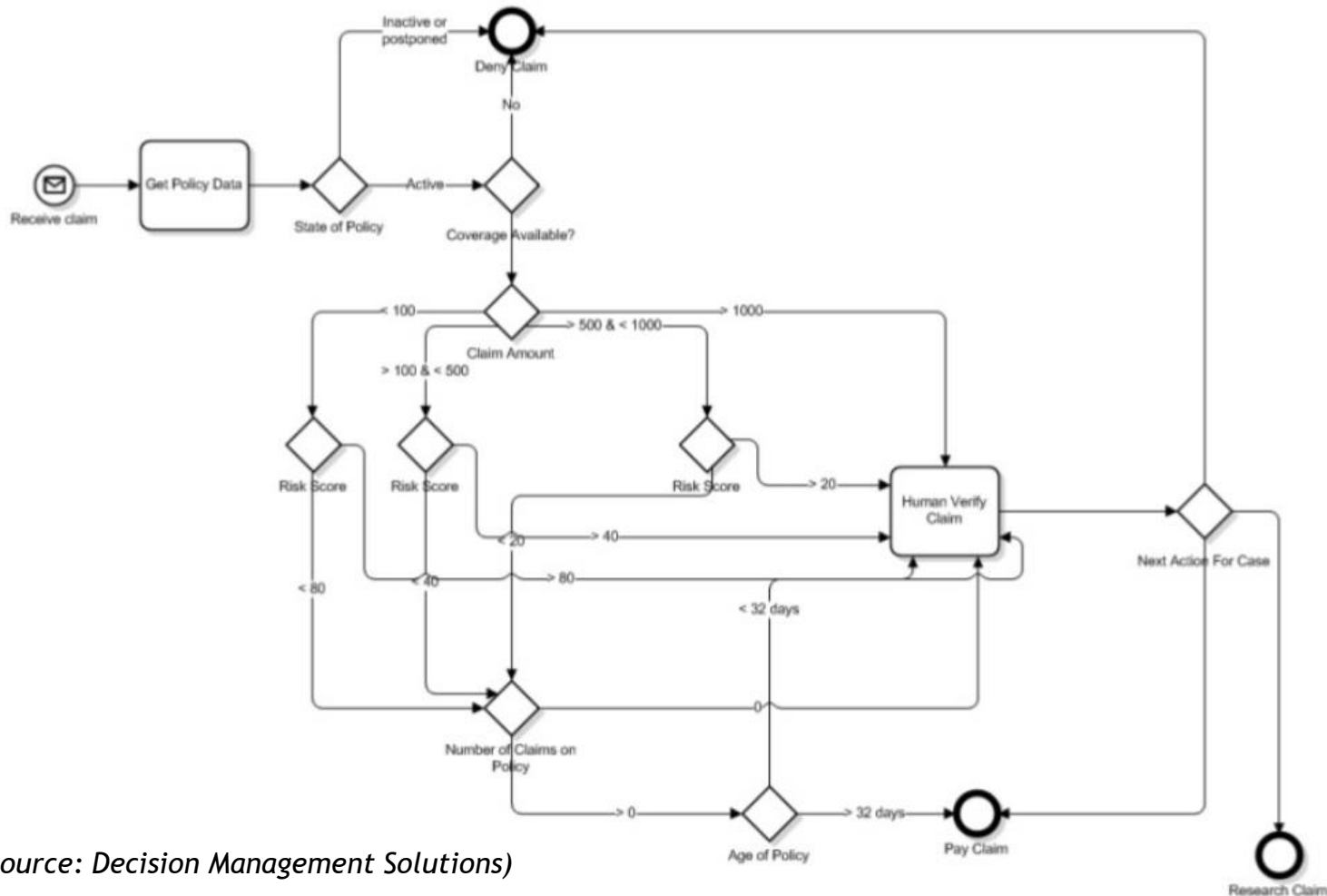
- * *Where is the decision?*
How is the decision logic modeled?
- * *Model the Decision activity: **Decide acceptance***



* Decisions and modeling



*Nested decision paths



(Source: Decision Management Solutions)

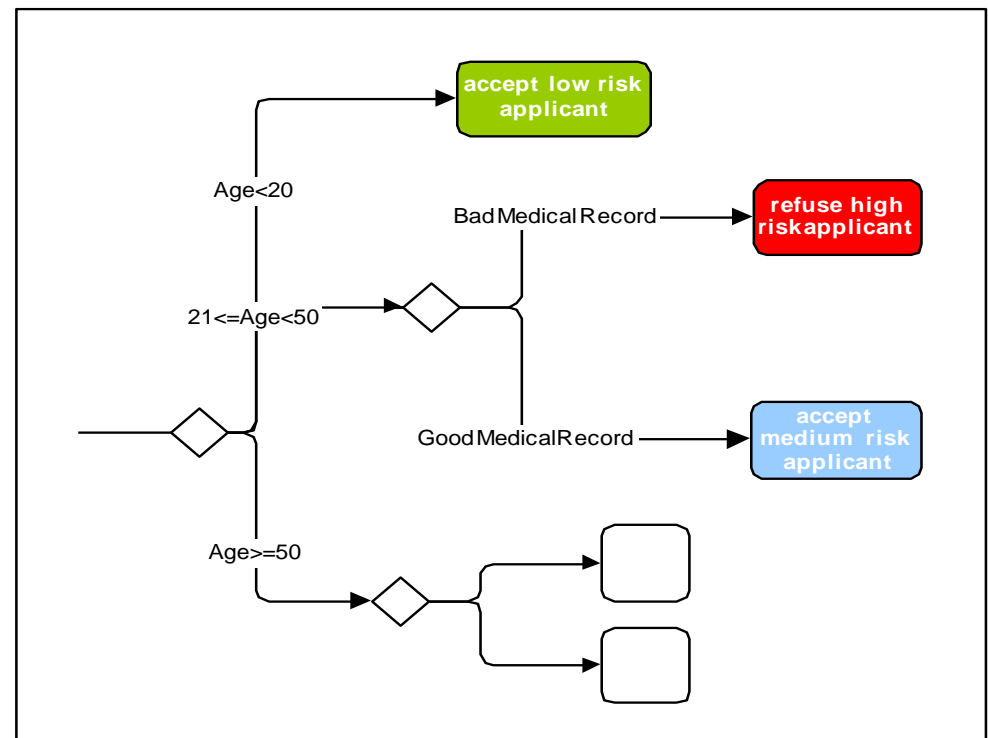
* Observation 2: decision paths?

Decision trees should not be process paths

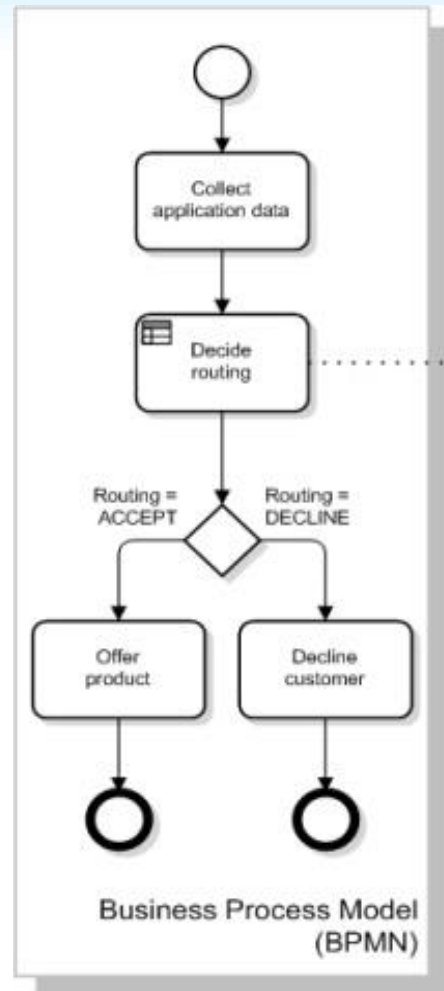
- * *Do not hardcode decision rules into the process model*
- * *Separating (decision) rules from the process simplifies the process*
- * *Simplify nested decision paths: **Decide applicant type***

Applicant type depends on:

- Age
- (and in some cases also Medical Record)



* Separate the rules from the process



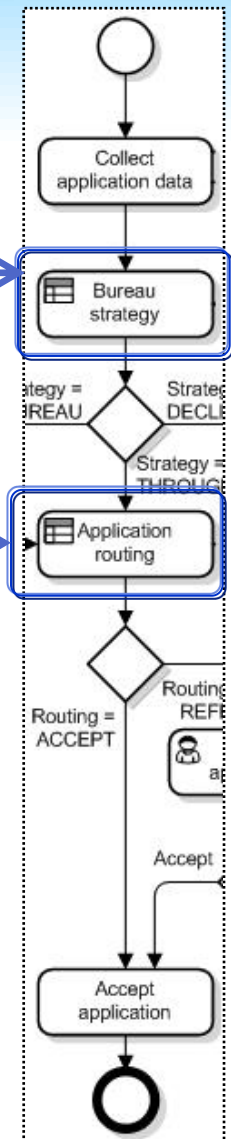
Rules to decide the routing

* Observation 3: multiple decisions

Decision models are not lower level details of one process

- * *Decisions models can span over multiple activities, and even multiple processes*
- * *Separation of concerns*

Model of the decision(s)



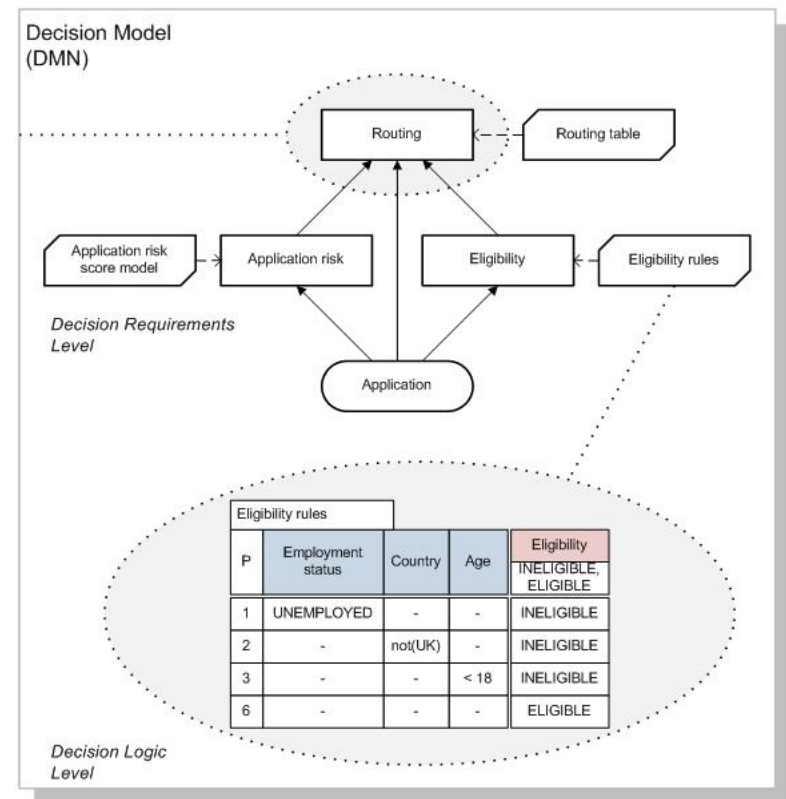
* Decisions and process are equal partners



* Observation 4: model decisions

Decision(s) (rules) need to be modeled

- * A standard for processes (BPMN) is not enough
- * Upcoming Decision Modeling & Notation standard (DMN)

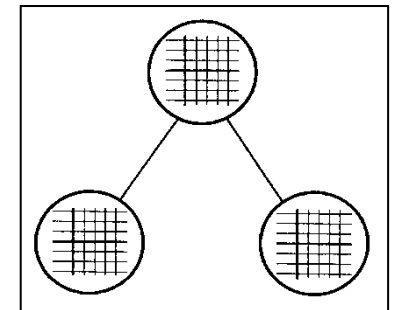


* Observation 5: proven techniques

Good decision table models are a proven technique to represent decision rules

Consistency, completeness and correctness by design

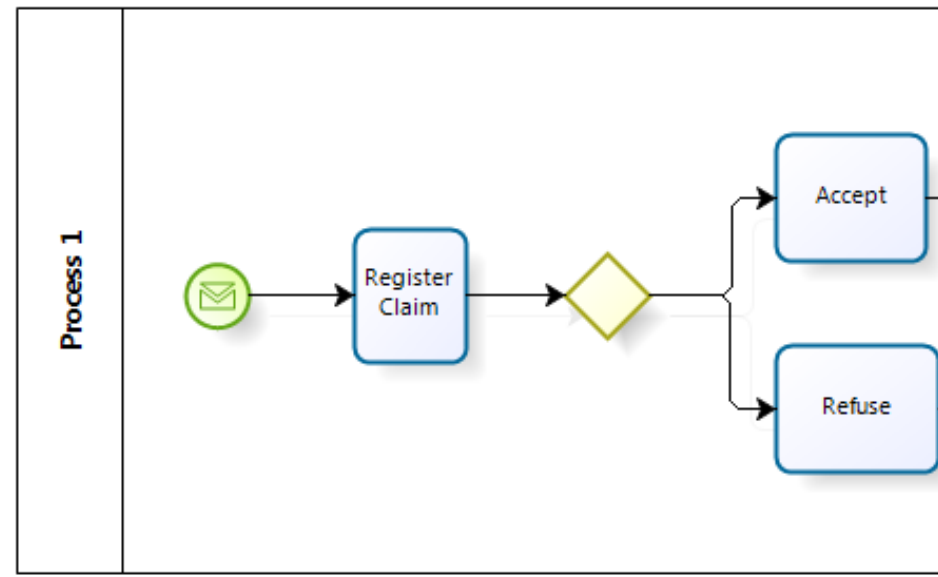
Applicant Risk Rating			
U	Applicant Age	Medical History	Applicant Risk Rating
1	> 60	good	Medium
2		bad	High
3	[25..60]	-	Medium
4	< 25	good	Low
5		bad	Medium



* Observation 6: the decision process

Sometimes the entire process is about a decision

- * *Model the decision first, and then think about how to execute it*
- * *The same decision can be processed in many ways*
- * *The process of making a decision depends on the desired criteria*
(throughput, efficiency, customer comfort, ...)



* Observation 7: business rules

There are many more business rules than decision rules

Behavioral rules & constraints, timing rules, task allocation rules, ...

If all you have is a hammer ...



Separate rules and processes

BPMN really stands for “Business People May Not...understand” (Jim Sinur's blog "Burn Baby Burn, August 2010)

Types	Start			Intermediate			End
	Top-Level	Event Sub-Process Interrupting	Event Sub-Process Non-Interrupting	Catching	Boundary Interrupting	Boundary Non-Interrupting	
None	○			○			○
Message	✉	✉	✉	✉	✉	✉	✉
Timer	⌚	⌚	⌚	⌚	⌚	⌚	
Error	⚠	⚠		⚠	⚠		⚠
Escalation	⚠	⚠		⚠	⚠	⚠	⚠
Cancel				✖			✖
Compensation	⏪			⏪			⏪
Conditional	☑	☑	☑	☑	☑	☑	
Link				➡			➡
Signal	⚠	⚠	⚠	⚠	⚠	⚠	⚠
Terminate							⦿
Multiple	⊕	⊕	⊕	⊕	⊕	⊕	⊕
Parallel Multiple	⊕	⊕	⊕	⊕	⊕	⊕	

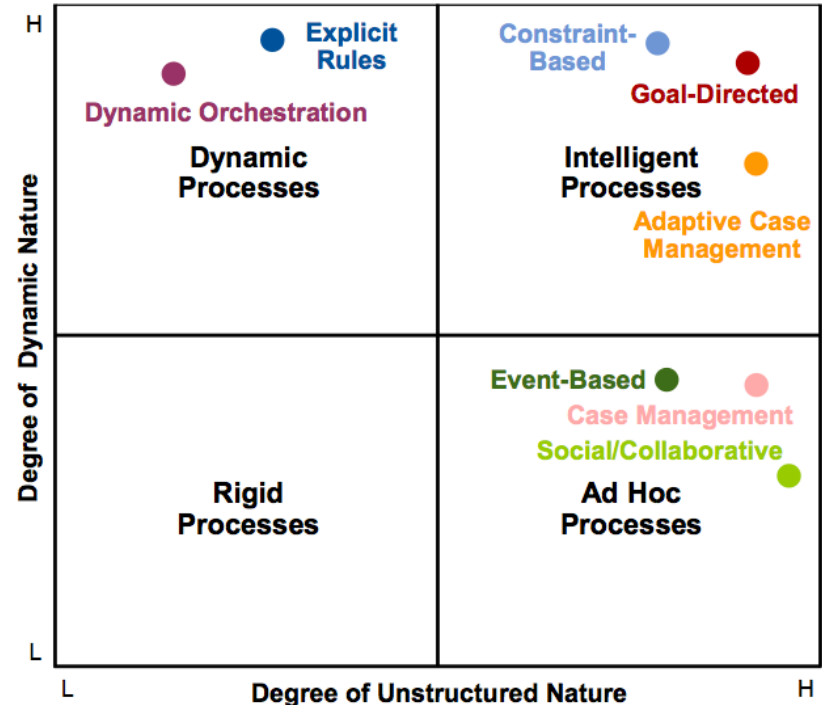


* Observation 8: the continuum

Business rules constrain and guide the process(es)

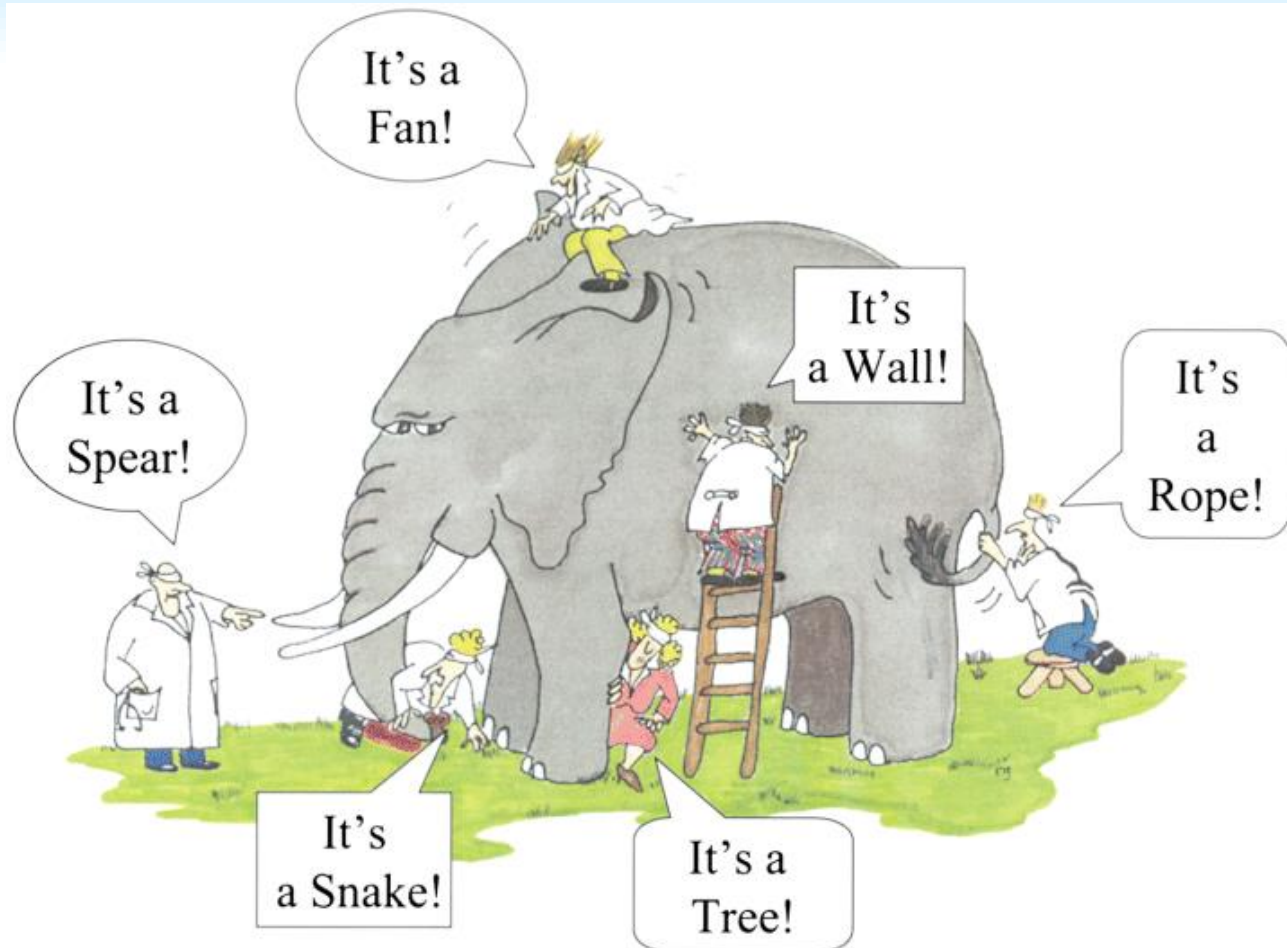
- * *The Process - Rule continuum*
- * *Declarative process modeling, smart BPM, smart decisions, smart business*

Figure 1. Axis of Adaptability



Source: Gartner (May 2013)

* Multiple models

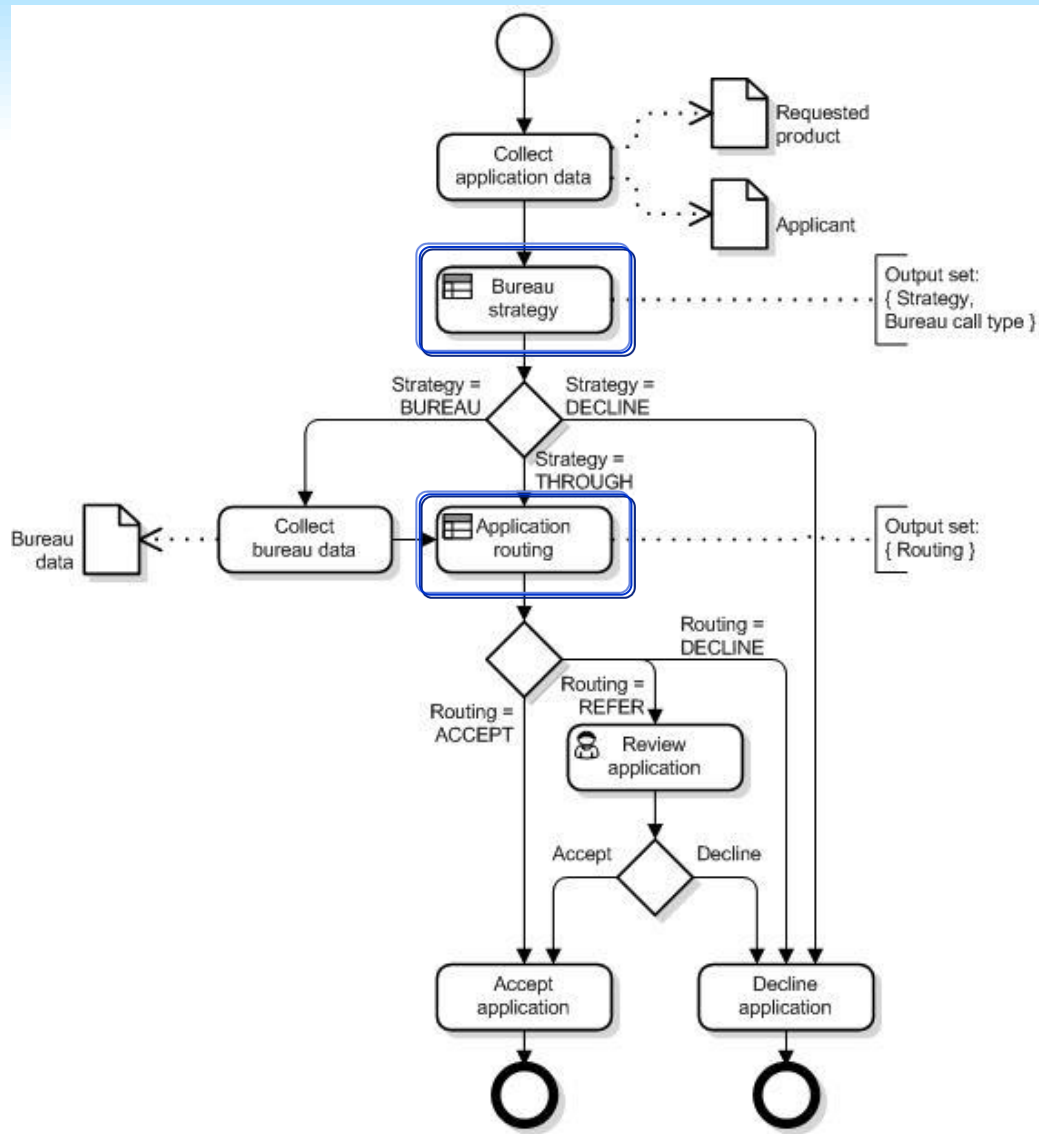


The blind men and the elephant. Poem by John Godfrey Saxe
(Cartoon G. Renee Guzlas, artist).

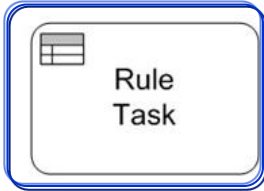


Decisions and processes

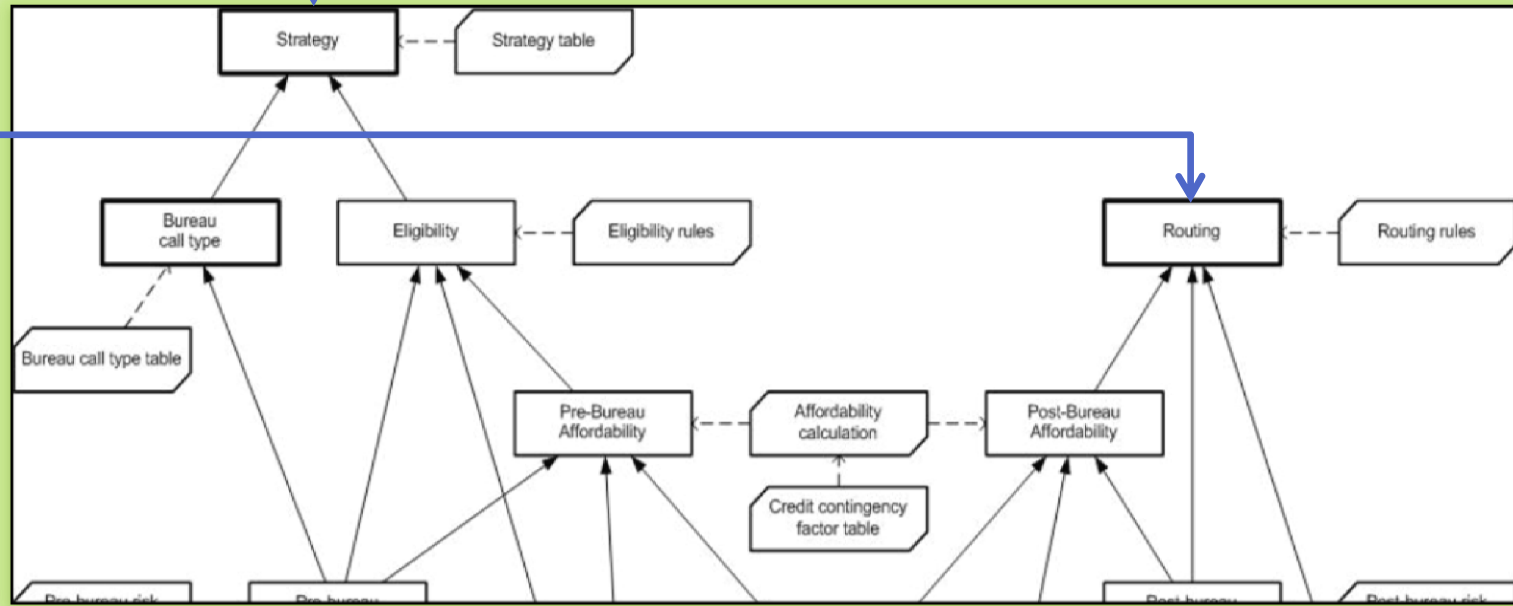
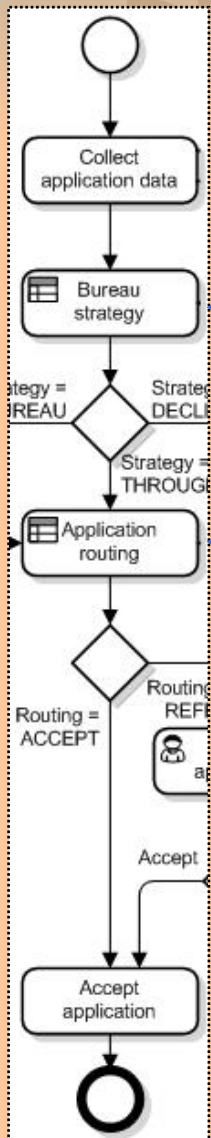
* Decisions need to be modeled



Decision Management
Decision Analytics
Decision Modeling



* Process and Decision Model



* Why separate decisions-processes?

- * The process can be rather stable
- * But the decision rules can change all the time



* Why separate decisions-processes?

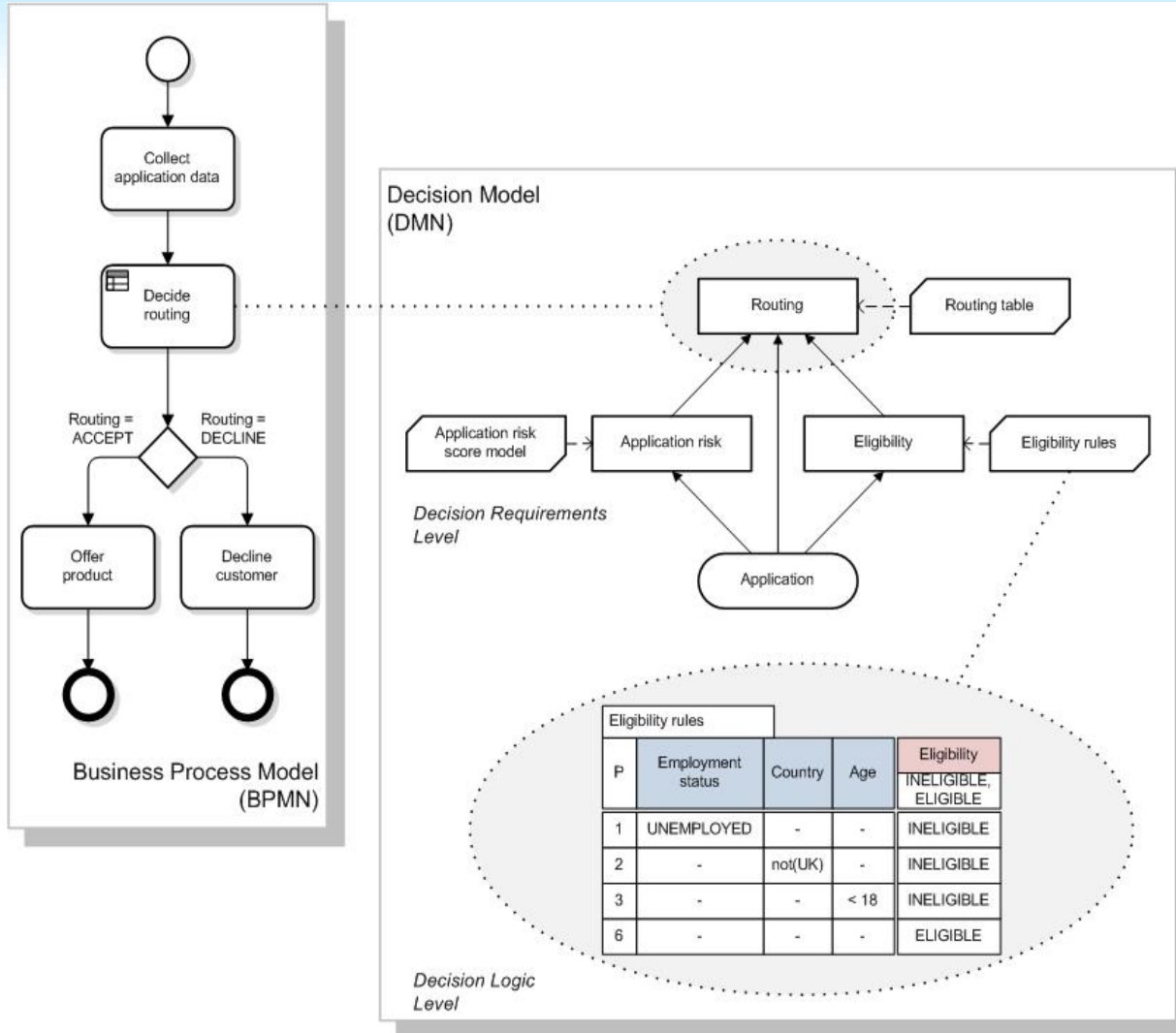
- * Simpler processes
 - * Different responsibilities, different stakeholders
 - * Different timing of changes
 - * Improved agility (change decision and keep process)
-
- * Simpler decision modeling and discovery
 - * Reuse decisions across processes
 - * Improved visibility and focus
 - * Automate manual decisions



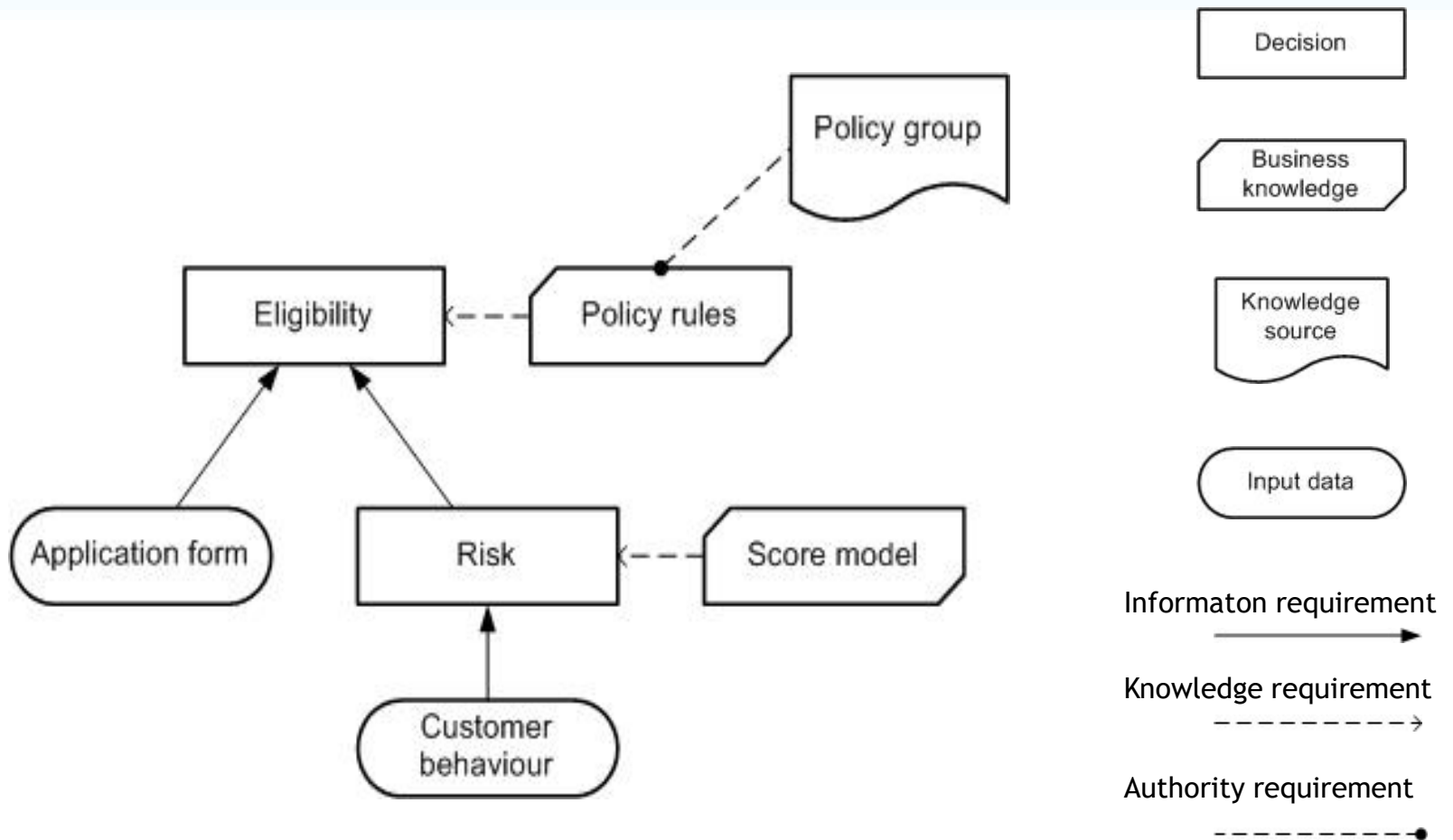
Decision model & notation



* DMN components



* Decision Requirements Graph



* *What to do, or how to do it?*

* What is to be decided? Possible outcomes?

* Decisions require:

* Input data

* Transactions

* Master data

* External data

* Decision logic

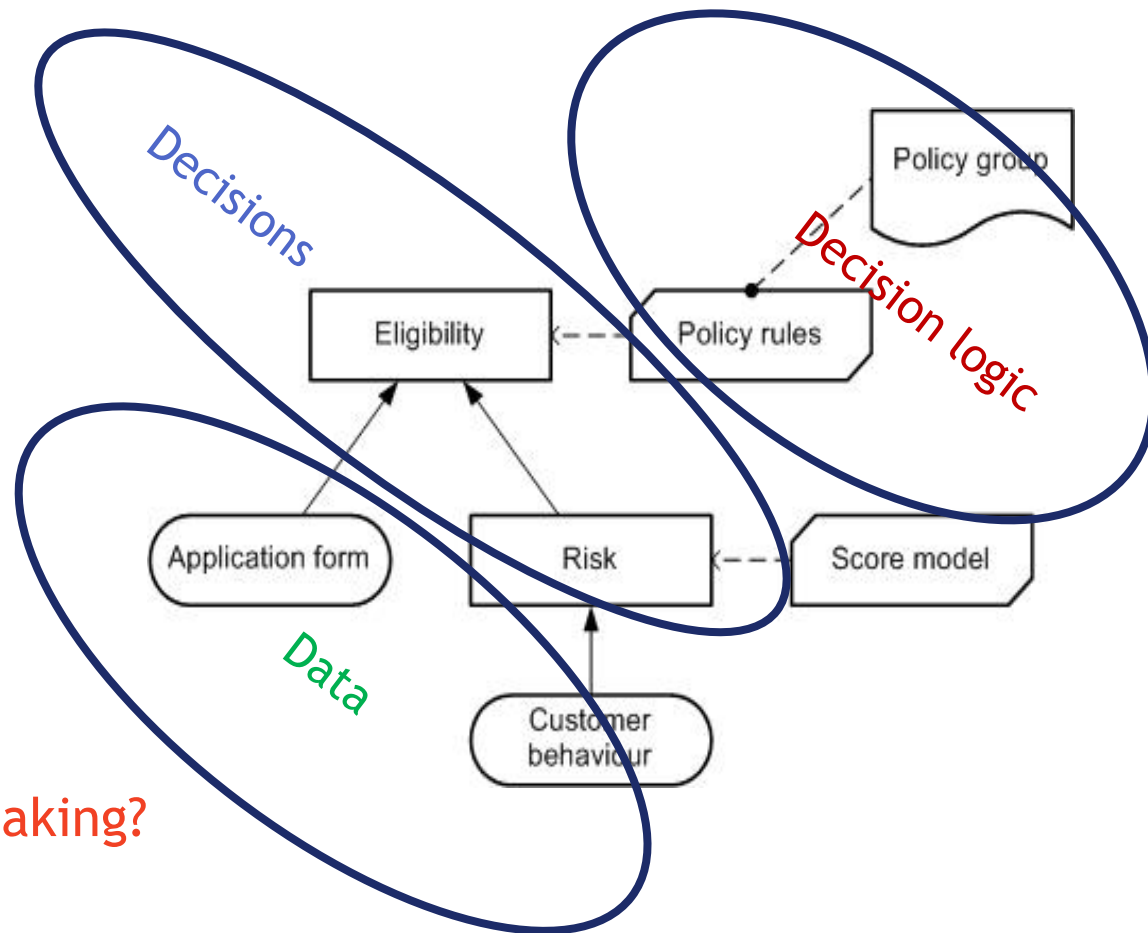
* Rules, knowledge

* Policies

* Analytics

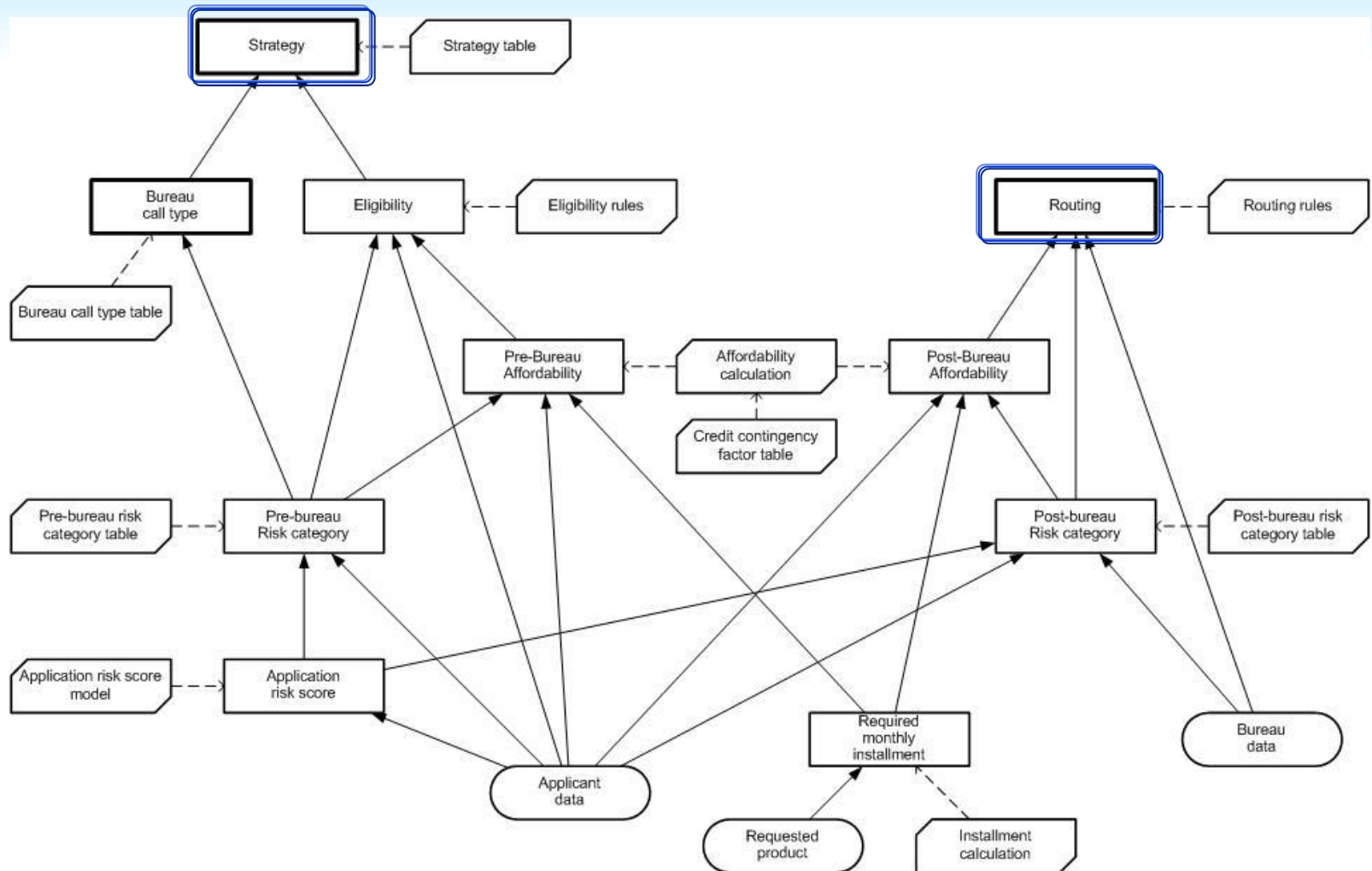
* Outcome of other decisions

* Reusability



* The process of decision making?

* Example: decision model



* Decision logic

* Natural language

- * Unclear, ambiguous

* Logic

- * Powerful, unambiguous, but not for business people

* Structured English Rules

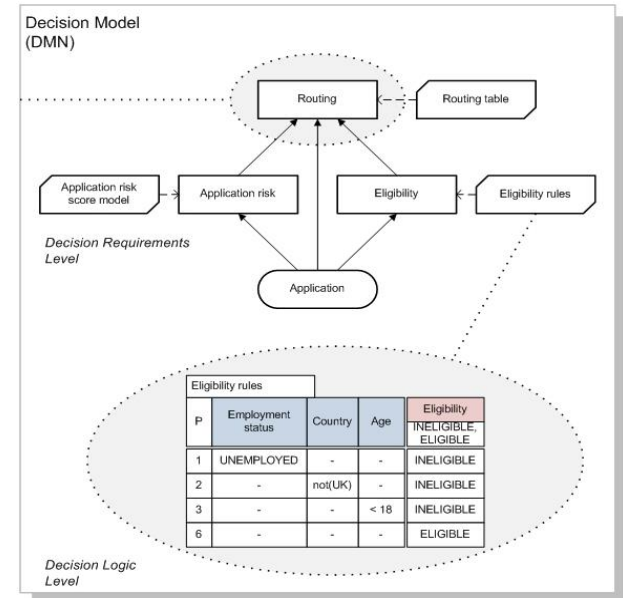
- * Subset of natural English
- * Trade-off between:
 - * easy of use (but not very powerful)
 - * powerful (but difficult to use)

* Decision trees, tables, graphs, diagrams

- * Different representations for different purposes:
acquisition, V&V, decision making, dependencies, impact analysis

* Object Constraint Language

- * Part of UML
- * Useful for pre- and postconditions





* Kim Clijsters' Tennis Ranking

“Clijsters becomes the world's number one if she reaches the final, OR If Davenport doesn't reach the final, OR Mauresmo doesn't win the tournament.

Lindsay Davenport stays number one if she wins the tournament AND Clijsters doesn't reach the final, OR she loses the final (against another player than Mauresmo) AND Clijsters loses in the semi-finals.

Amélie Mauresmo becomes number one if she wins the tournament and Clijsters loses in the quarter-finals. ”

(translated from www.sporza.be, ...)

1. Clijsters	goes out before semi-final				
2. Davenport	goes out before final		runner-up		wins tourn.
3. Mauresmo	does not win tourn.	wins tourn.	does not win tourn.	wins tourn.	-
1. Cijsters number 1	x	x	x	.	x
2. Davenport number 1	x
3. Mauresmo number 1	.	x	.	x	.
	1	2	3	4	5

1. Clijsters	looses semi-final			runner-up or wins
2. Davenport	goes out before final	runner-up or wins tourn.		-
3. Mauresmo	-	does not win tourn.	wins tourn.	-
1. Cijsters number 1	x	x	.	x
2. Davenport number 1	.	x	.	.
3. Mauresmo number 1
	6	7	8	9

* Tables, methodology and standard

* Decision tables (DT)

- * Decision rules in a tabular format

* Decision table methodology (DTM)

- * How to use a constrained form of decision tables in order to model decisions
- * Goal-oriented decision modeling network
- * Good decision table design
- * Single hit tables (complete, consistent and correct), relations between tables, table notation, contraction, optimization, normalization.

* Decision Modeling & Notation (DMN) standard

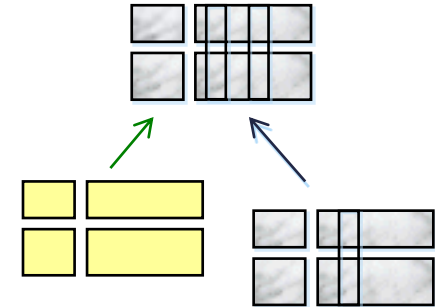
- * Standard syntax and notation for exchange
- * Recognize other forms of tables
- * Combine tables with other concepts in decision modeling
- * Standard expression language

* Modeling Issues

- The global model

Decision table hierarchy

A condition subtable returns the outcome of a decision and uses it in another table



- The detailed model

Decision table construction

Kinds of tables

	Car group	Booked >= 3 days in advance	Duration (D=Daily, W=Weekly, M=Monthly)	Discount 10%	Discount €50.00
1	Compact	Y	-	x	.
2		N	-	.	.
3	Mid-sized, Full Sized, Luxury, Sport, Utility, Minivan	Y	D	x	.
4			W	x	x
5			M or (other)	x	.
6		N	D	.	.
7		N	W	.	x
8			M or (other)	.	.
9	(other)	Y	-	x	.
10		N	-	.	.

* DMN Decision Logic

* Decision tables

- * Single hit (returns 1 rule with outcome(s))

 - * Default:

 - If rules are non-overlapping: **unique hit**

 - * Recognize others:

 - If rules are overlapping, the 1 rule has to be selected:
any hit, first hit, priority hit

- * Multiple hit (returns a list of rules)

* DMN Types of tables (single hit)

DMN identifies different table types, indicated by the first letter:

- * **unique hit** tables: every input case is included in one rule only. There is no overlap between rules. Good
- * **any hit** tables: every input case may be included in more than one rule, but the outcomes are equal. Rules are allowed to overlap. Ugly
- * **priority hit** tables: multiple rules can match, with different outcome values. This policy returns the matching rule with the highest output value priority (e.g. highest discount).
- * **first hit** tables: multiple (overlapping) rules can match, with different outcome values. The first hit by rule order is returned (and evaluation can halt). This is a common usage, because it resolves inconsistencies by forcing the first hit. Bad

It is important to distinguish this type of table from others because the meaning depends on the sequence of the rules. Because of this sequence, the table is hard to validate manually and therefore has to be used with care.

Tables with redundancy (ugly)

Overlapping rows (but with the same conclusion)

	TypeOfOrder	CustomerLocation	TypeofCustomer	SpecialDiscount
1	Web	US	Wholesaler	10%
2	Phone			Not Applicable
3		non-US		Not Applicable
4			Retailer	Not Applicable

-> multiple rows can apply: what if one is changed? **Contradiction**

This is a list of rules, not a good decision table (where is Phone, non-US?)

The better version:

	TypeOfOrder	CustomerLocation	TypeOfCustomer	SpecialDiscount
1	Web	US	Wholesaler	10%
2			Retailer	Not Applicable
3		non-US	-	Not Applicable
4	Phone	-	-	Not Applicable

First-hit tables (bad)

First hit table (overlapping rows but with different conclusions)

	TypeOfOrder	CustomerLocation	TypeofCustomer	SpecialDiscount
1	Web	US	Wholesaler	10%
2	Phone			Not Applicable
3		non-US		Not Applicable
4			Retailer	5%

-> multiple rows can apply: take the first hit (requires sequence!)
Hard to validate. This is a list of rules, not a good decision table

The better version:

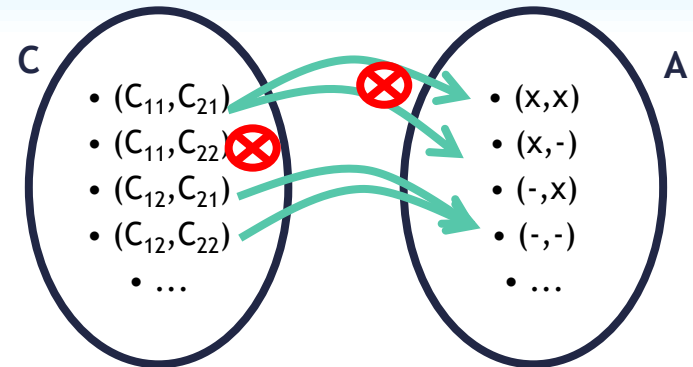
	TypeOfOrder	CustomerLocation	TypeOfCustomer	SpecialDiscount
1	Web	US	Wholesaler	10%
2			Retailer	5%
3		non-US	-	Not Applicable
4	Phone	-	-	Not Applicable

*The decision table as relation

• Exclusivity

column 4 subsumes column 1

1. Credit Limit ?	Ok	Not Ok	Not Ok	-	Ok	Ok	Ok
2. Customer	Good	Not Good	Good	Good	Good	Not Good	Not Good
3. Stock Sufficient ?	Y	-	N	Y	N	N	Y
1. Execute Order	x	-	-	x	-	-	x
2. Refuse Order	-	x	-	-	-	-	-
3. Put On Waiting List	-	-	x	-	x	x	-
	1	2	3	4	5	6	7



• Completeness

1. Credit Limit ?	Ok	Not Ok			
2. Customer	-	Good	Not Good		
3. Stock Sufficient ?	Y N	Y N	-		
1. Execute Order	x	- x	-		
2. Refuse Order	-	- -	x		
3. Put On Waiting List	-	x -	-		
	1	2	3	4	5

1. Customer ?	Good	Good	Not Good	Not Good
2. Quantity Ordered	Q<10	Q>=10	Q<10	Q>=20
1. Discount := 5%	-	x	-	-
2. Discount := 2%	x	-	x	-
3. Discount := 0%	-	-	-	x
	1	2	3	4

* Case

2011: Gwen (from insurance):

“Jan, I attended your presentation last year, and we applied the ideas you told us. I must thank you. What used to take 5 people for 5 months is now done by 1 person in 2 weeks or less. And ...”

2012: Gwen & Kate :

*Actually, it saves the company
2.9 million \$*

... a year

*2013: Hey Jan, good news,
we got promoted this year.*

The screenshot shows the BRCommunity.com website. The header includes the logo and tagline: "THE WORLD'S MOST TRUSTED RESOURCE FOR BUSINESS RULE AND DECISION MANAGEMENT PROFESSIONALS". Below the header is a search bar and navigation links. The main content area features a "Case Studies" section with the title "Decision Tables Saved Our Project from Failure!" and the author "by Gwen Bradshaw". The article text begins with "“Easier said than done” — this is a phrase I heard myself mumbling as Ron Ross presented the principles of good business rules during the BBC conference in October of 2010. It had been a tough decision to take time away". To the left of the article is a sidebar with a "Sponsored by Business Rule Solutions, LLC" box and a "COMMENTARY" section listing several names.

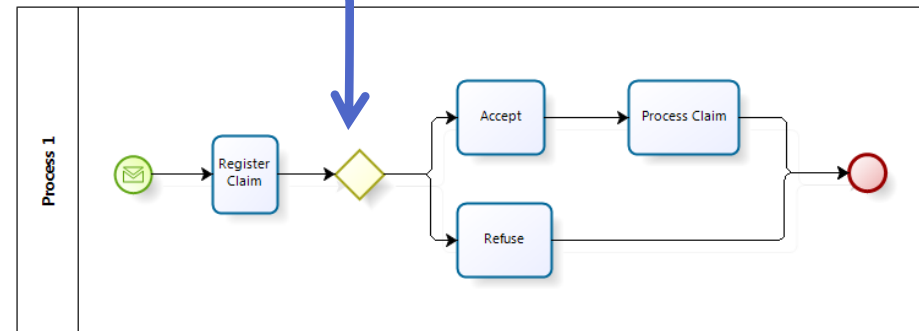
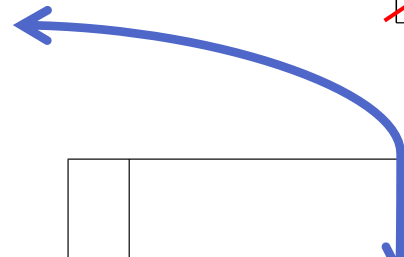
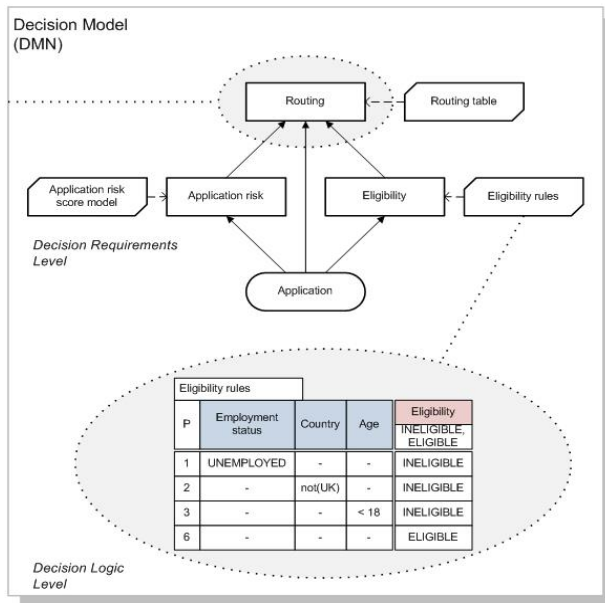
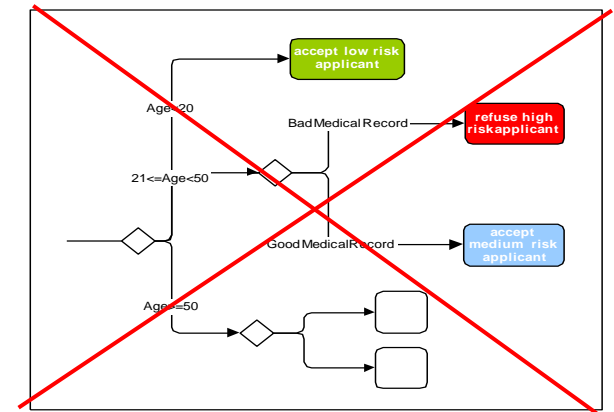
* Issues DMN solves



* Issues DMN solves

* *Separating decisions and processes*

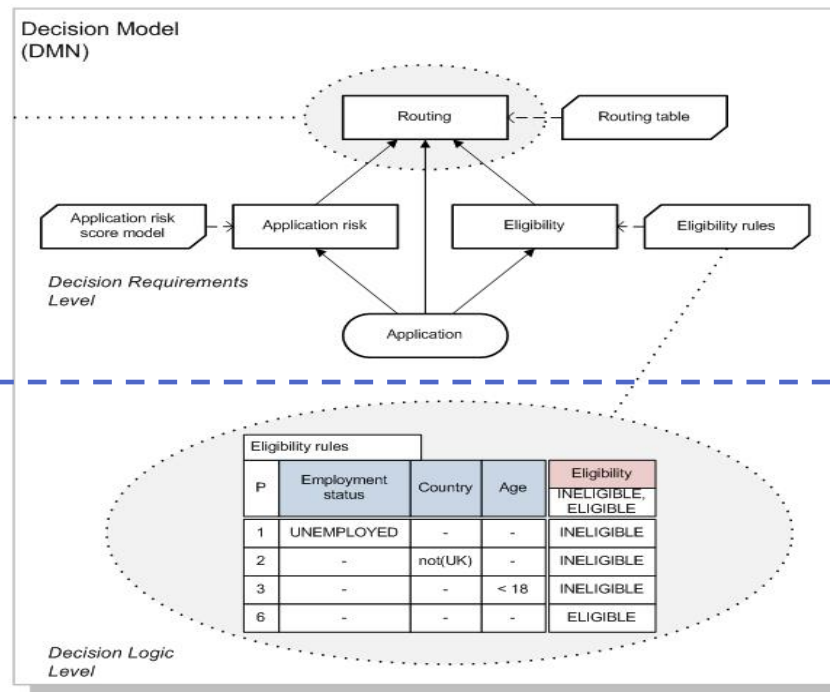
* *Using a standard modeling notation.*



* Issues DMN solves

* *Separating decision structure and decision logic*

- * Allows to model decision relations, even if not all logic is expressed in tables.



* Issues DMN solves

* *Decision modeling methodology*

- * **Good** decision table models are a proven technique to represent decision rules
*Consistency, completeness and correctness **by design***

* *Decision table types*

- * Recognize, and unambiguously exchange.

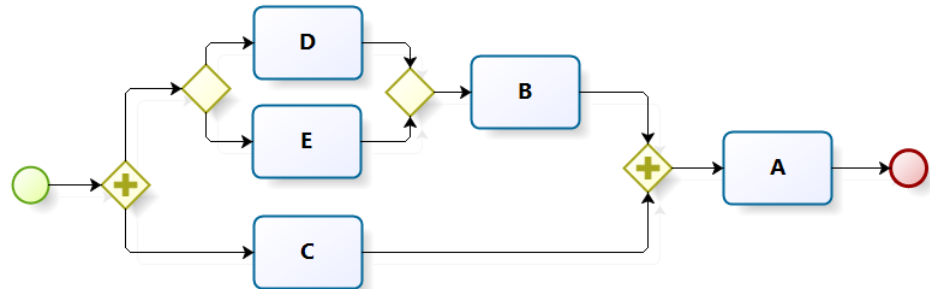
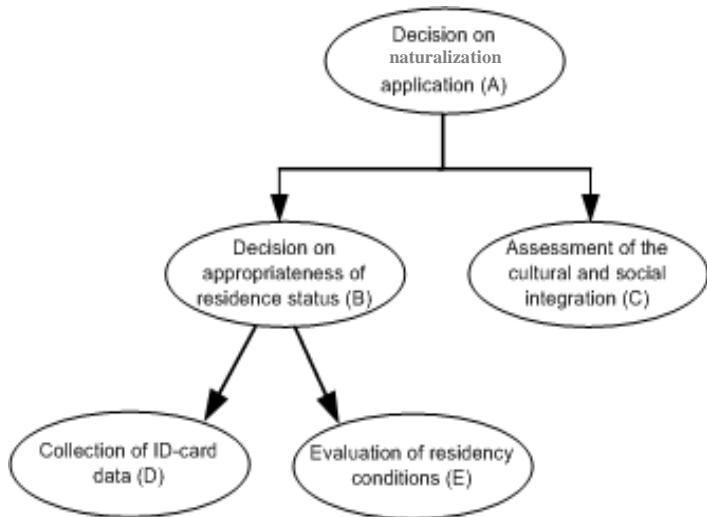
* *Standard notation for exchange and implementation*

- * Strict notation and simple expression language ((S-)FEEL).
- * FEEL (“Friendly Enough Expression Language) implements the required mechanisms
- * S-FEEL (“Simple FEEL”) is a basic subset of FEEL designed to cover the essential requirements of Decision Table-based DMN models

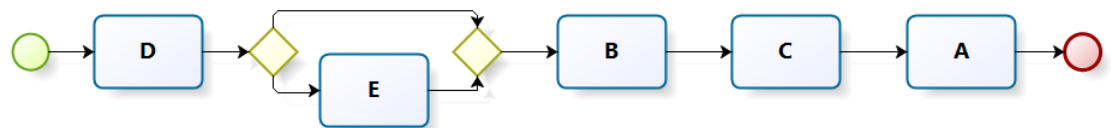


The Decision Process

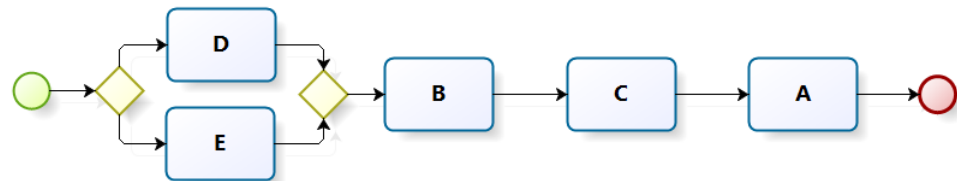
* From decisions to processes



Start each individual decision activity as soon as all its preconditions are fulfilled



Avoid superfluous decision activities (unnecessary work)



Group customer contacts

*The basic message

*First make it correct

- * Overview, Consistency, Format, Verification, Business View, Analysis, ...
- * Make sure the business can do it

*Then you can make it efficient, optimal

- * If it executes automatically, fine
- * If the execution is optimized, even better

*Thank you



* Classic References

- * Codasyl, A Modern Appraisal of Decision Tables, Report of the Decision Table Task Group, ACM, New York, 1982
- * CSA, (1970): Z243.1-1970 for Decision Tables, Canadian Standards Association, 1970.
- * Goedertier, S. and Vanthienen, J. (2007). Declarative Process Modeling with Business Vocabulary and Business Rules. In Halpin, T., Nijssen, S., and Meersman, R., editors, *Proceedings of Object-Role Modeling (ORM'07)*, Lecture Notes in Computer Science (Springer), volume 4805, pp. 603-612.
- * Huysmans J, Dejaeger K, Mues C, Vanthienen J, Baesens B, An empirical evaluation of the comprehensibility of decision table, tree and rule based predictive models, 2011, *Decision Support Systems*, vol. 51, no. 1, pp. 141 - 154.
- * Moreno A, Verhelle M and Vanthienen J, *Decision tables: An Overview of the Existing Literature*, GIACA, Information Technologies in Accounting, Fifth International Conference on Artificial Intelligence and Emerging Technologies in Accounting, Finance and Tax (Huelva, Spain 2000)
www.econ.kuleuven.ac.be/prologa/download/overview82-2000.pdf
- * Vanthienen, J. (2007). How Business Rules (Re)define Business Processes: A Service Oriented View, *10th International Business Rules Forum*, Orlando, FL (USA), Oct. 21-25.
- * Vanthienen J, Mues C, Aerts A, *An illustration of verification and validation in the modelling phase of KBS development*, *Data & knowledge engineering*, vol. 27, no. 3, pp. 337–352, 1998.
- * Vanthienen, J., Wets, G. (1995), Integration of the decision table formalism with a relational database environment, *Information Systems*, vol. 20, no. 7 (Nov.), pp. 595 - 616.
- * Vanthienen J., Wijzen J., *On the Decomposition of Tabular Knowledge Systems*, *New Review of Applied Expert Systems*, pp. 77-89, 1996.
- * Vanthienen J., Snoeck M., *Knowledge Factoring Using Normalization Theory*, *International Symposium on the Management of Industrial and Corporate Knowledge (ISMICK'93)*, Compiègne (FR), pp. 97-106, October 27-28, 1993.