Port Clearance (Refactored Solution)

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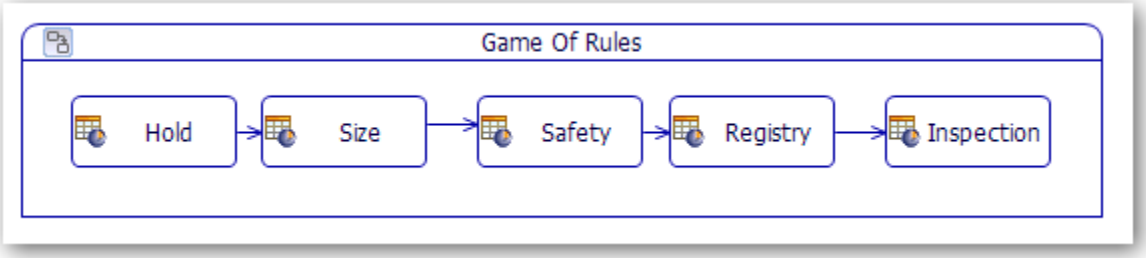
Refactoring the "As Specified" Decision model

We'll discuss how the original model can be refactored to make it simpler and we'll also discuss how a couple of enhancements might affect the model.

Decision Structure



Below are each of the rules represented as decision tables (using the natural language view).

Hold Rules

A ship's hold contains remainders of cargo if the residual cargo measurement is higher than 0.5 mg dry weight per cm².

The hold of a ship must be considered clean if the hold does not contain remainders of cargo

Conditions	1	2
What is the residual cargo measurment in the hold?	<= 0.5	> 0.5
Actions		
Post Message(s)		
The hold is considered clean	✓	
The hold has no remainders of cargo	✓	
The hold is not considered clean		✓
The hold has remainders of cargo		✓

What if there are new reasons why the ship might have remainders? Where should we model that? e.g. radioactive. Additional factors could be added easily

Conditions	1	2	3
What is the residual cargo measurement in the hold?	<= 0.5	> 0.5	
Was radioactivity detected in the hold?	F		T
Actions			
Post Message(s)			
The hold is considered clean	✓		
The hold has no remainders of cargo	✓		
The hold is not considered clean		✓	✓
The hold has remainders of cargo		✓	✓

Size Rules

A ship must be categorized as small if the total length of the ship is less than 80 meters

A ship must be categorized as large if the total length of the ship is at least 80 meters

Conditions	1	2	3
What is the length of the ship in meters?	< 80	>= 80	null
Actions			
Post Message(s)			
Classify the ship as	'small'	'large'	'unknown'

NOTE: We should consider the possibility of any attribute being null.

What if there is an overlap between small and large? Suppose the rules said small was under 80 but large was over 60? What size is a ship of length 70?

Conditions	1	2
What is the length of the ship in meters?	< 80	>= 60
Actions		
Post Message(s)		
Classify the ship as	'small'	'large'

Fortunately Corticon can detect this situation using its ambiguity checker

Conditions	1	2
What is the length of the ship in meters?	< 80	>= 60
Actions		
Post Message(s)		
Classify the ship as	'small'	'large'

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Total conflicts detected: 1

We might decide to resolve it this way and then we'd need to accommodate 'medium' in the safety rules below.

Conditions	1	2	3
What is the length of the ship in meters?	< 60	60..80	> 80
Actions			
Post Message(s)			
Classify the ship as	'small'	'medium'	'large'

Safety Rules

A ship only meets the safety requirements for large unloaded ships if the ship complies with all of the following:
- the ship is categorized as large
- the hold of the ship is clean
- the hold of the ship is double hulled.

A ship only meets the safety requirements for small unloaded ships if the ship complies with all of the following:
- the ship is categorized as small
- the hold of the ship is clean

Conditions	1	2	3	4	5
What is the size of the ship?	'small'	'small'	'large'	'large'	'large'
Is the ship's hold clean?	T	F	T	F	-
Is the ship double hulled?	-	-	T	-	F
Actions					
Post Message(s)					
The ship does meet the safety requirements	☑		☑		
The ship does not meet the safety requirements		☑		☑	☑

A ship only meets the safety requirements for unloaded ships if the ship complies with at least one of the following:
- the ship meets the safety requirements for small unloaded ships
- the ship meets the safety requirements for large unloaded ships.

Incidentally Corticon can compress this by merging rules 2 and 4 since their outcome is the same:

Conditions	1	2	3	4
What is the size of the ship?	'small'	{'large', 'small'}	'large'	'large'
Is the ship's hold clean?	T	F	T	-
Is the ship double hulled?	-	-	T	F
Actions				
Post Message(s)				
The ship does meet the safety requirements	☑		☑	
The ship does not meet the safety requirements		☑		☑

Registry

A ship's certificate of registry must be considered valid if the date up to which the registration is valid of the certificate of registry is after the current date

Conditions	1	2
Is the expiry date of the certificate of registration after today?	T	F
Actions		
Post Message(s)		
The ship has a valid certificate of registration	✓	
The ship does not have a valid certificate of registration		✓

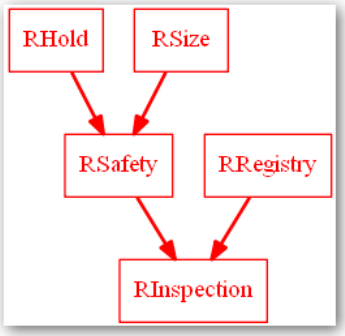
Inspection

A ship must comply with the requirements of the Inspection for unloaded ships if the ship complies with all of the following:
- the ship meets the safety requirements for unloaded ships
- the ship has a certificate of registry that is valid.

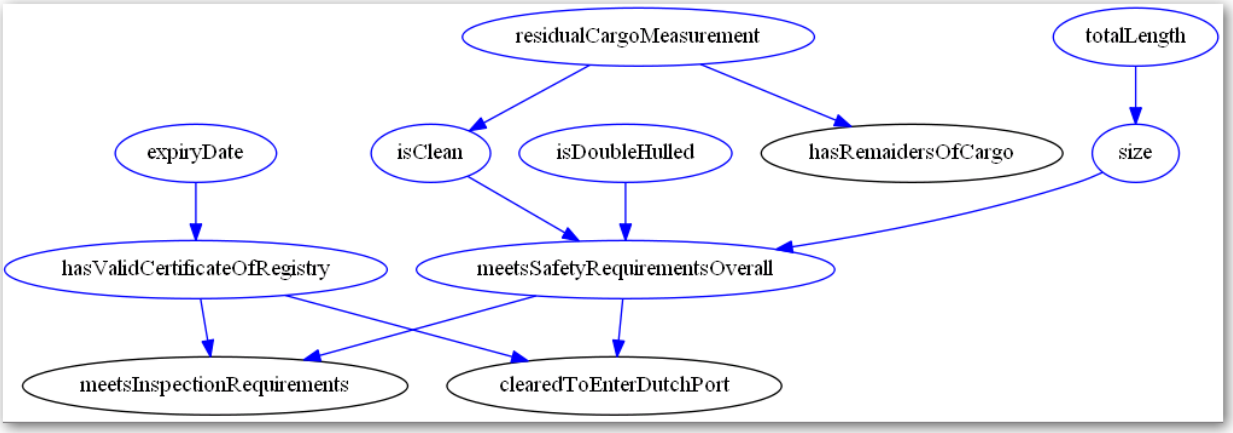
An unloaded ship may only enter a Dutch port if the ship complies with the requirements of the Inspection for unloaded ships.

Conditions	1	2	3
Does the ship meet safety requirements?	T	F	-
Does the ship have a valid certificate of registry?	T	-	F
Actions			
Post Message(s)			
The ship does meet inspection requirements	✓		
The ship does not meet inspection requirements		✓	✓
The ship is cleared to enter a Dutch port	✓		
The ship is NOT cleared to enter a Dutch port		✓	✓

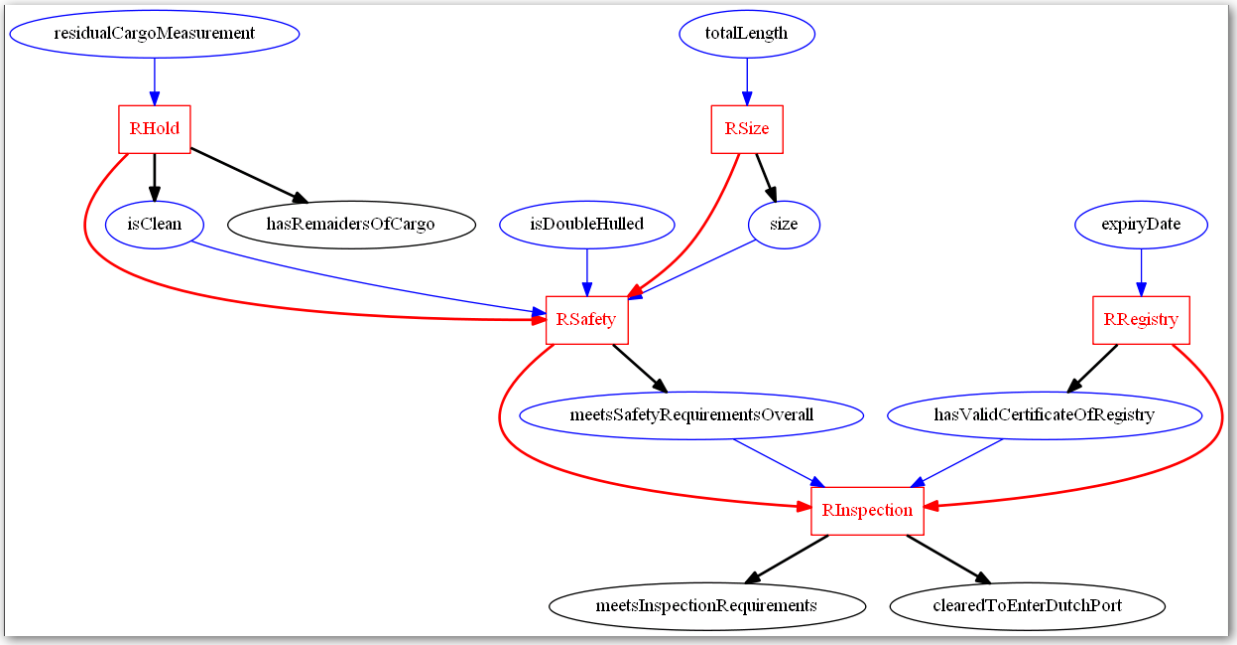
Rule Sheet Dependency



Attribute Dependency



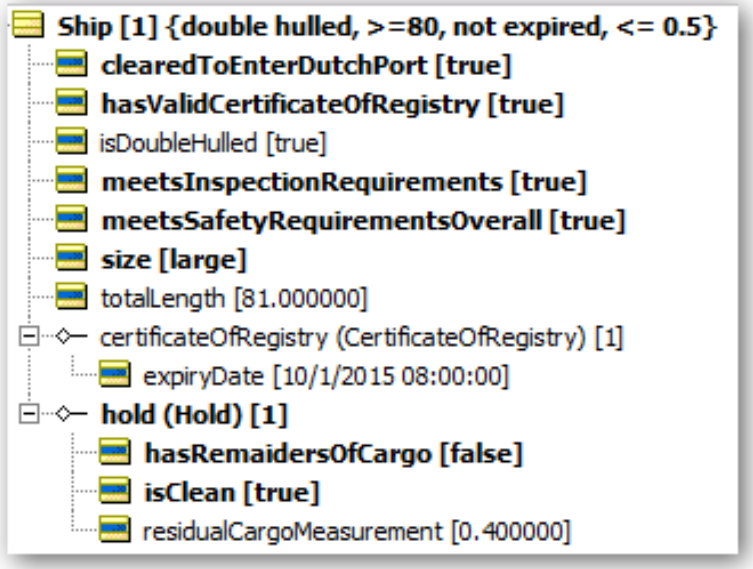
Combined Dependency Diagram



You can see in the refactored model which attributes are not used (black with no exit line)

Test Cases

A Ship that may enter a Dutch port



Notice that the rule statements have been slightly changed to read as statements of fact about the ship being considered along with an explanation. The notes in [ ] indicate the rule sheet and rule that produced the message. These messages become the decision audit trail. In some cases actual values have been inserted.

Sev...	Message
Info	[Hold,1] The ship's hold does not contain remainders of cargo since the residual cargo measurement is not over 0.5 mg dry weight per cm².
Info	[Hold,1] The hold of the ship is considered clean since the hold does not contain remainders of cargo
Info	[Size,2] The ship is categorized as large since the total length of the ship (81.000000) is at least 80 meters
Info	[Safety,3] The ship meets the safety requirementsfor large unloaded ships since the ship complies with all of the following:- the ship is ca...
Info	[Registry,1] The ship's certificate of registry is considered valid since the date (10/1/2015 08:00:00) up to which the registration is valid ...
Info	[Inspection,1] the ship meets the safety requirements for unloaded ships
Info	[Inspection,1] the ship has a certificate of registry that is valid.
Info	[Inspection,1] The ship may enter a Dutch port since the ship complies with the requirements of the Inspection for unloaded ships: safety...

A Ship that may not enter a Dutch port

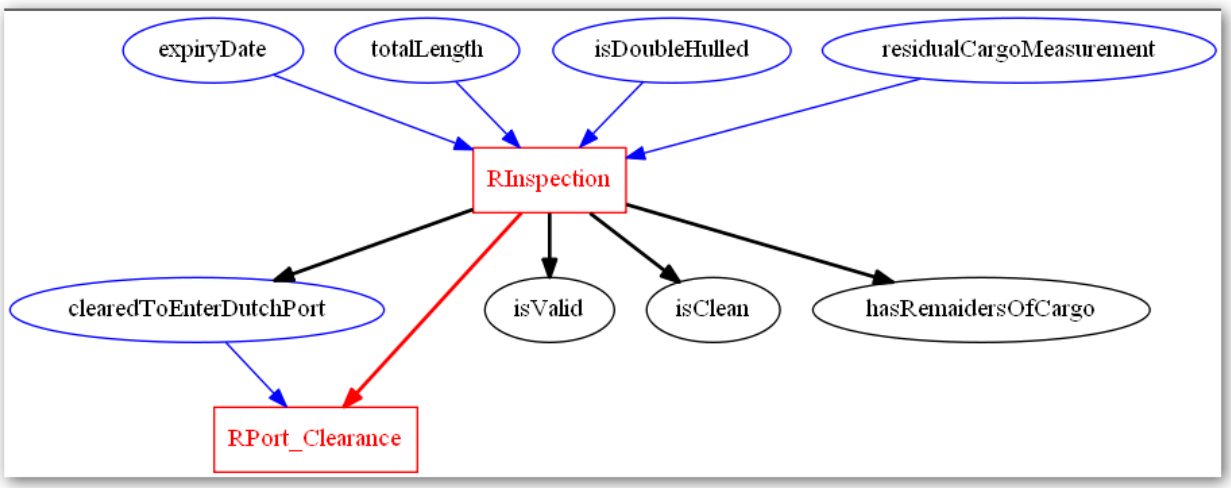
- **Ship [14] {not double hulled, >=80, expired, >0.5}**
  - **clearedToEnterDutchPort [false]**
  - **hasValidCertificateOfRegistry [false]**
  - isDoubleHulled [false]
  - **meetsInspectionRequirements [false]**
  - **meetsSafetyRequirementsOverall [false]**
  - **size [large]**
  - totalLength [81.000000]
  - certificateOfRegistry (CertificateOfRegistry) [14]
    - expiryDate [10/1/2014 08:00:00]
  - **hold (Hold) [14]**
    - **hasRemaidersOfCargo [true]**
    - **isClean [false]**
    - residualCargoMeasurement [0.600000]

Warning	[Hold,2] The ship's hold contains remainders of cargo since the residual cargo measurement is higher than 0.5 mg dry weight per c...	Ship[14]
Warning	[Hold,2] The hold of the ship is considered NOT clean since the hold does contain remainders of cargo	Ship[14]
Info	[Size,2] The ship is categorized as large since the total length of the ship (81.000000) is at least 80 meters	Ship[14]
Warning	[Safety,4] The hold is not clean so does not meet the safety requirements	Ship[14]
Warning	[Safety,5] The ship is not double hulled so does not meet the safety requirements (for large ships)	Ship[14]
Warning	[Registry,2] The ship's certificate of registryis considered NOT valid since the date (10/1/2014 08:00:00) up to which the registra...	Ship[14]
Warning	[Inspection,2] The ship does not meet inspection requirements since it does not meet the safety requirement	Ship[14]
Violation	[Inspection,2] The ship may not enter a Dutch port since it does not meet the inspection requirements	Ship[14]
Warning	[Inspection,3] The ship does not meet inspection requirements since it does not have a valid certificate of registry	Ship[14]

Consolidating the Rules

Note: It is possible to put all the rules in one sheet by testing the four attributes that are input to the decision. Effectively there are just five rules that implement the original ten rules.

Conditions	1	2	3	4	5
What's the total length of the ship	< 80	>= 80	>= 80	-	-
How much residual cargo does the hold have?	< 0.5	< 0.5	< 0.5	>= 0.5	-
Is the ship double hulled?	-	T	F	-	-
Does the ship have a valid certificate of registry?	T	T	-	-	F
Actions					
Post Message(s)					
The ship is cleared to enter a Dutch port	T	T	F	F	F
Remainders of Cargo	F	F	F	T	
Hold is clean	T	T	F	F	
Certificate is valid	T	T			F



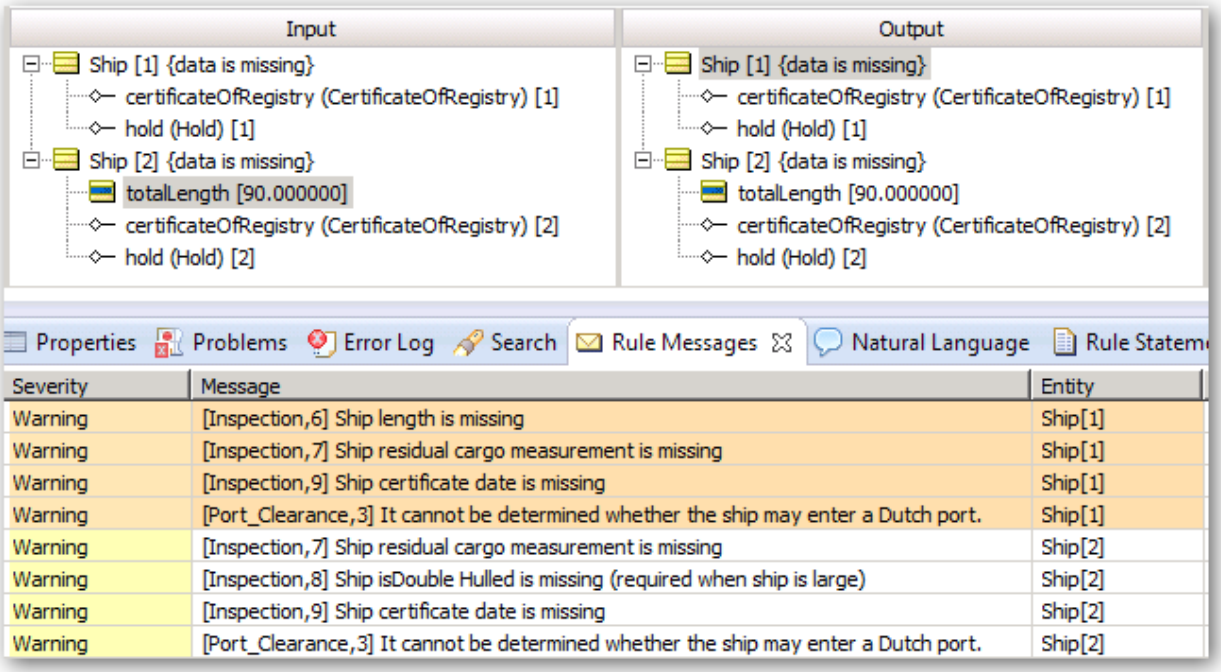
Dealing with Bad data

Running the completeness checker will tell us that we do not have rules to deal with missing data

Conditions	1	2	3	4	5	6	7	8	9
What's the total length of the ship	< 80	>= 80	>= 80	-	-	null	-	>= 80	-
How much residual cargo does the hold have?	< 0.5	< 0.5	< 0.5	>= 0.5	-	-	null	-	-
Is the ship double hulled?	-	T	F	-	-	-	-	null	-
Does the ship have a valid certificate of registry?	> now	> now	-	-	<= now	-	-	-	null
Actions									
Post Message(s)									
The ship is cleared to enter a Dutch port	T	T	F	F	F				
Remainders of Cargo	F	F	F	T					
Hold is clean	T	T	F	F					
Certificate is valid	T	T			F				

We could also customize the rule statement messages:

Ref	Post	Alias	Text
			MAY ENTER A DUTCH PORT
1	Info	Ship	The ship is small since its length is less than 80 meters
2	Info	Ship	The ship is large since its length is at least 80 meters
1:2	Info	Ship	The ship's hold is clean since residual cargo is less than 0.5
1:2	Info	Ship	The ship has a certificate of registry that is valid because it has not yet expired
1:2	Info	Ship	The ship meets the safety requirement.
1:2	Info	Ship	The ship complies with the requirements of the Inspection for unloaded ships.
			MAY NOT ENTER A DUTCH PORT
3	Warning	Ship	The ship does not meet inspection requirements since it is large but not double hulled
4	Warning	Ship	The ship does not meet inspection requirements since it has residual cargo
5	Warning	Ship	The ship does not meet inspection requirements since it has an expired certificate
			INVALID DATA
6	Warning	Ship	Ship length is missing
7	Warning	Ship	Ship residual cargo measurement is missing
8	Warning	Ship	Ship isDouble Hulled is missing (required when ship is large)
9	Warning	Ship	Ship certificate date is missing



Appendix A The Rules (from RuleXpress)

1. Clean

***Statement** The hold of a ship must be considered clean if the hold does not contain remainders of cargo.

2. Clearance Dutch Port

***Statement** An unloaded ship may only enter a Dutch port if the ship complies with the requirements of the Inspection for unloaded ships.

3. Inspection requirements

***Statement** A ship must comply with the requirements of the Inspection for unloaded ships if the ship complies with all of the following:
- the ship meets the safety requirements for unloaded ships
- the ship has a certificate of registry that is valid.

4. Large ship

***Statement** A ship must be categorized as large if the total length of the ship is at least 80 meters.

5. Remainders of cargo

***Statement** A ship's hold contains remainders of cargo if the residual cargo measurement is higher than 0.5 mg dry weight per cm^2.

6. Safety requirements

***Statement** A ship only meets the safety requirements for unloaded ships if the ship complies with at least one of the following:
- the ship meets the safety requirements for small unloaded ships
- the ship meets the safety requirements for large unloaded ships.

7. Safety requirements large

***Statement** A ship only meets the safety requirements for large unloaded ships if the ship complies with all of the following:
- the ship is categorized as large
- the hold of the ship is clean
- the hold of the ship is double hulled.

8. Safety requirements small

***Statement** A ship only meets the safety requirements for small unloaded ships if the ship complies with all of the following:
- the ship is categorized as small
- the hold of the ship is clean.

9. Small ship

***Statement** A ship must be categorized as small if the total length of the ship is less than 80 meters.

10. Valid certificate of registry

***Statement** A ship's certificate of registry must be considered valid if the date up to which the registration is valid of the certificate of registry is after the current date.