blueriq
TSS
MAKE YOUR OWN RULES

Case Study: Vehicle Insurance UServ Product Derby

By Maarten P.D. Schadd
Product Consultant at Blueriq B.V.

Contents

1 Introduction

The decision management community [1] is a new initiative that started in 2014 to facilitate the sharing of news and knowledge concerning Decision Management (DM). Next to a product catalog, decision model prototypes and case studies, the decision management community also provides a monthly challenge. Every challenge consists of a problem that should be solved using any business rules and decisions management system or none at all.

As Blueriq is a vendor with an integrated rule engine and decision management capabilities in its BPM suite, we accept this challenge. This article describes how Blueriq solves the Dec-2014/Jan-2015 challenge.[1]

2 Problem definition

More than ten years ago, Business Rule Forums (now Building Business Capability - BBC) challenged Business Rule (BR) vendors with the "UServ Product Derby" case to demonstrate their capabilities. The decision management community decided to revive this case as a challenge in the context of decision management.

The case concerns a fictitious case of UServ Financial Services, an insurance company that provides a full service portfolio of financial products. The case focuses on a clients application for car insurance. Based on the background of the customer and the type of car(s) insured, a risk indication is determined that influences the amount that the customer has to pay annually for his/her insurance. A detailed description can be downloaded at [2].

The case study includes three different scenarios of customers that apply for car insurance. We show the results of these scenarios in Section 6. There are no correct outcomes specified. So there is no way of knowing if you found the correct answer before the submission. Only after the publication of other solutions you are able make a comparison. As there exist quite a few rules that are ambiguous, we are interested to know if two different challenge participants provided the exact same outcome.

3 Domain

In Blueriq, the basis when developing an application is the domain model. The complete domain model created for this challenge is shown in Figure 1. The data type of each attribute can mostly be deducted from the attribute name (e.g., `Car.HasAlarm` is a boolean, `Car.Price` is a currency, `Driver.Age` an integer and `Client.Segment` is a string). `Car` and `Driver` are multitons as it is possible to insure multiple cars and drivers under one policy. `Client` is singleton, as only one client applies for insurance at the same time. There are no relations defined between the entities. For instance, there was no logic in the case that concerned specifics on which driver was using which car, which would have justified a relation.

As is visible in Figure 1, the domain is quite large, and we are not going to discuss every attribute in detail here. We just want to point out some special cases that may rise questions to the attentive reader.

- Name - The `Car` and `Driver` entity both have a name attribute. This is just used for identifying cars in an overview table and is not necessary for the logic in any way.

[1] Due to the size of the challenge, and the vacation period, it was decided that this particular challenge runs two months instead of one.

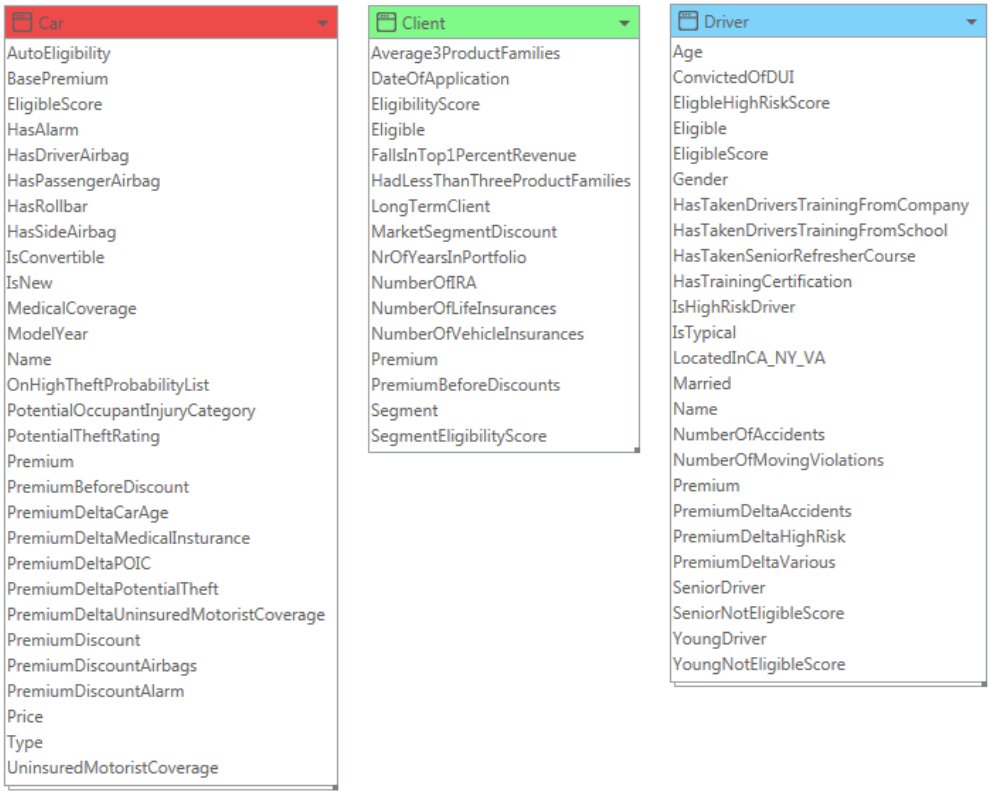

Figure 1: The Entity Relationship Diagram

- `Driver.LocatedInCA_NY_VA` is a boolean attribute that represents that the user lives in any of these three states. This attribute could be removed and replaced with a string attribute for the state code of the customer. Whether or not he lives in any of those three special states could be made part of the logic. For simplicity, we decided to leave this as a simple boolean input attribute.
- Some attributes are just used for intermediate results, such as `Car.PremiumDelta[X]` and `Driver.PremiumDelta[X]`.

4 Business Rules

The case consists of many business rules and we do not discuss each of them here. We show an overview of the logic using a decision requirements graph in Subsection 4.1, and zoom in on specific interesting elements in Subsection 4.2. In Section 5 we discuss specific rules for which multiple interpretations are possible.

4.1 Decision Requirements Graphs

Blueriq is able to accurately display the requirements for making a decision at design time [3]. An interesting example is the decision requirements graph for the calculation of the overall premium

that the client is going to pay. This graph is too large to show in a single figure, and we have decided to split this graph up in multiple figures that follow one another on the next pages. In order to obtain one complete decision rule graph it is possible to combine Figures 2-4 into one single large rule graph.

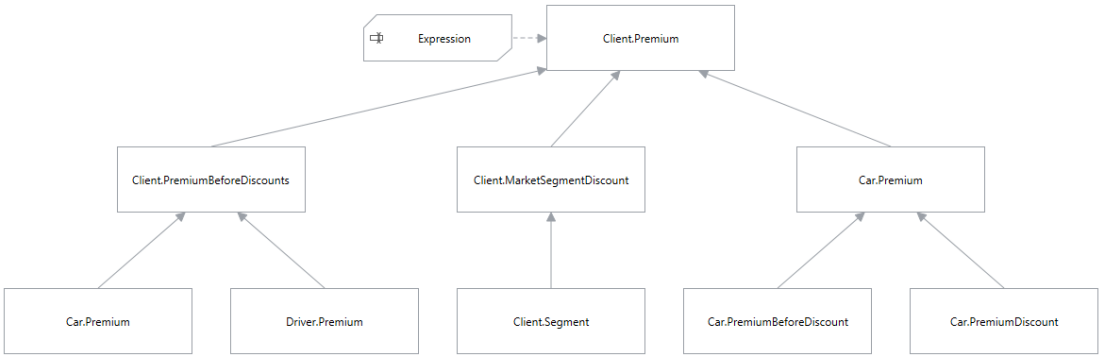

Figure 2: Three levels of DRG for the calculation of the overall premium of the client.

As you can see at the decision `Car.Premium`, the decision requirements graph is actually, unlike its name suggests, a decision requirements tree, as `Car.Premium` is shown twice. In Figure 2 `Car.Premium` is shown twice. This has to do with the rule for calculating the premium of the client.

> After all discounts have been applied, the annual premium must be greater than or equal to the sum of the base premium for all the cars on the policy.

The reference to `Car.Premium` on the left side of Figure 2 is due to the annual premium which depends on all discounted premiums for persons and cars. The reference to `Car.Premium` on the right side of Figure 2 belongs to the base premium for all the cars on the policy.

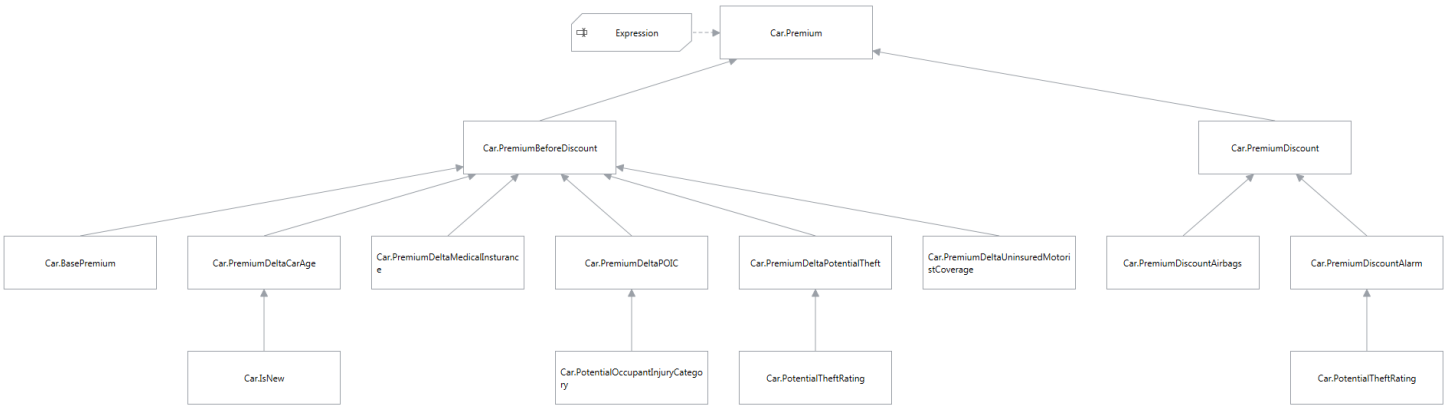

Figure 3: The DRG for the premium of a car.

For every element shown in such a DRG in Blueriq, it is possible to add the business knowledge models to the diagram. This is demonstrated in Figure 5 for determining if a client is a long-term client.

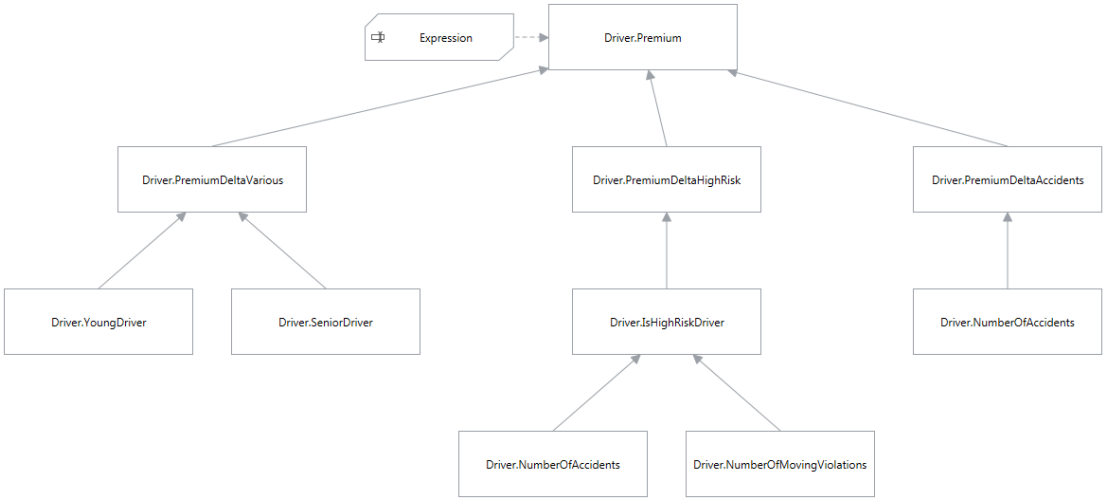

Figure 4: The DRG for the premium of a driver.

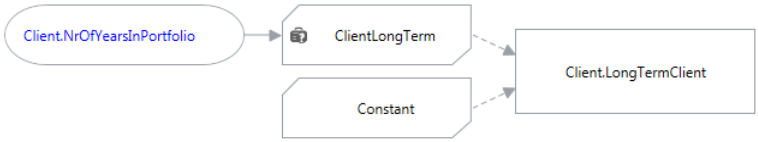

Figure 5: The knowledge model for determining if a client is a long-term client.

We see that the one business rule and a constant is used. The business rules is dependent on one input attribute, shown on the left. From this view, it is possible to directly open the definition of the corresponding elements in Blueriq.

4.2 Logic Elements

This section describes in detail several logic elements that are used for the application. The presented elements here are only an excerpt of all elements that are needed, as enlisting all would result in a tediously long document. Non-presented elements can be supplied upon request.

The premium that a client pays

We calculate the total premium that a client pays by using an expression as default value for this attribute. This definition of this attribute is shown in Figure 6.

The corresponding rule in the specification document was already stated in Subsection 4.1. The premium of the client before discounts is altered with a discount amount with possible values of 0, -250 or -500. The max function is used to compare this value with the sum of all car premiums. We created a reusable expression for this, indicated by {}. This expression is in fact only needed by this calculation, and could be removed, but we keep it for aesthetic reasons. The reusable expression is shown in Figure 7. This expression collects all car premiums known to the system and takes their sum.

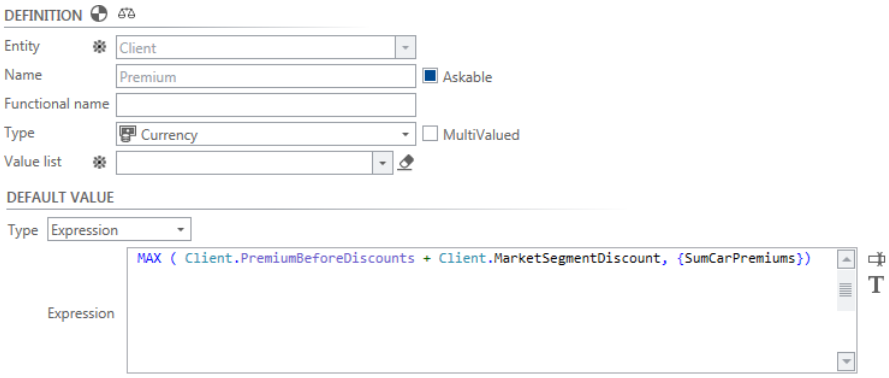

Figure 6: The definition of the `client.premium` attribute.

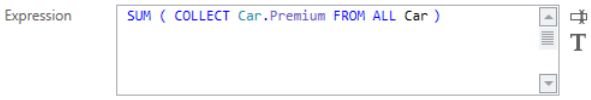

Figure 7: A reusable expression to compute the sum of all car premiums.

The change of the premium of the driver due to various influences

The case states that the premium corresponding to the driver is influenced by the number of accidents that he or she had, if the driver has a high risk rating, and various other influences. The decision table shown in Figure 8 concerns only these various influences.

Driver.YoungDriver	TRUE		[]		
Driver.SeniorDriver	*		TRUE		
Driver.LocatedInCA_NY_VA	TRUE		FALSE	TRUE	FALSE
Driver.Married	TRUE	FALSE	*	*	*
Driver.PremiumDeltaVarious	700	720	300	500	200

Figure 8: A decision table to compute the change of the premium of the driver due to various influences.

This table is evaluated from top to bottom, and contains several special characters. the two brackets [] indicate that any non-mentioned option matches. In this example, if the driver is a young driver, the left path is taken, but for all other values, the right path is taken. A star * indicates that the attribute on the left side of this row does not matter for this path. It does for example not matter if the driver is married or not if he or she is a senior driver. As you see in the first two rows of this decision table, we combine the decision for young and senior drivers into one decision table. It would also be possible to create two separate decision tables for these two cases, but we chose to do it in one to be able to see the complete logic in one table.

Car moderate theft rating

Each car has a potential theft rating that is based on the price and if a car is on the list of cars that have a high theft probability. For each category, we create a business rule to derive it.[2] Figure 9 shows the business rule to derive a moderate theft rating.

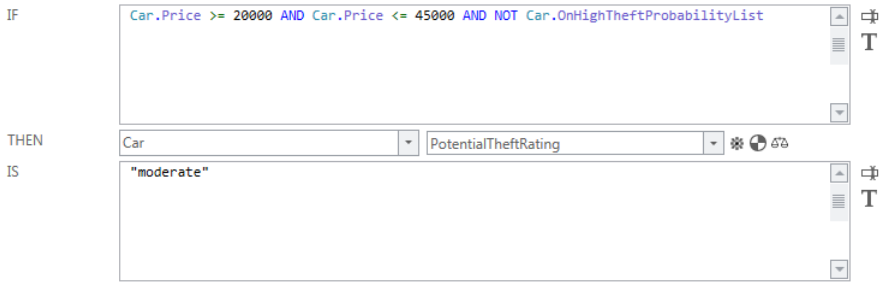

Figure 9: A business rule that determines that a car has a moderate theft rating.

If the car price is between 20.000 and 45.000 and the car is not on the list of high theft probability cars, then the potential theft rating of the car is moderate.

Preferred Client Status

A client has a status, upon which a discount is applied. The special case with this status is that the insurance company decides to change the rule at some point, but wants this only applicable for new clients, and old clients should still be treated the old way. Blueriq knows the concept of Rule Groups that are suited for constructs like these. In a rule group you can select a set of business rules or decision tables that are only valid and can be used by the rule engine, if the precondition of this rule group is true. We created two business rules that determine if a client has a preferred status, shown in Figures 10 and 11.

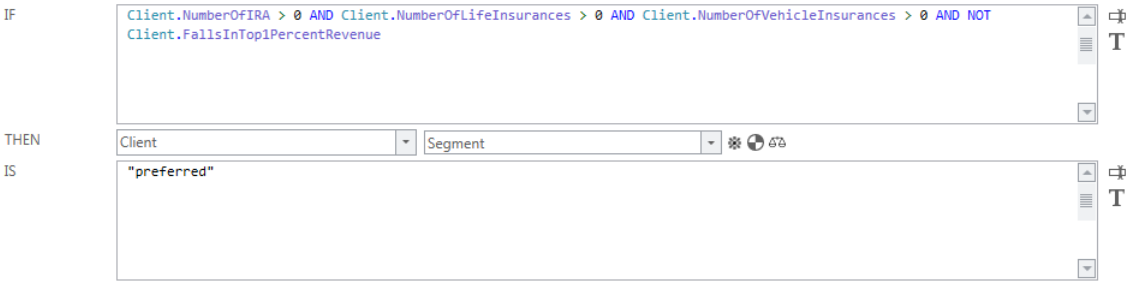

Figure 10: The old rule for preferred clients.

Now, we create two rule groups, shown in Figures 12 and 13. For old clients the old preferred client rule holds. A client is classified as old if the date of application is more than a year ago and if since the introduction of the new rule the client never had less than three product families in their portfolio. For new clients, i.e. the client applied in the past year, the new rule holds.

[2] Please note that it was also possible to create one large decision table.

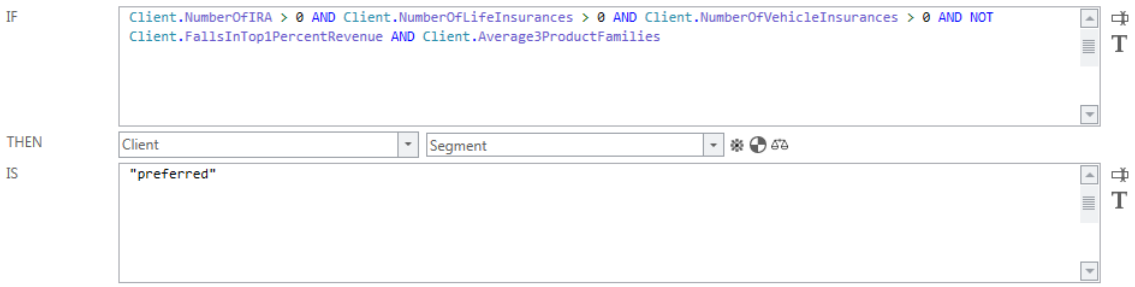

Figure 11: The new rule for preferred clients.

We chose to indicate an existing client to have applied longer than a year in the past. This is currently a rolling window, meaning that the window will be different when the application is started on another day. For a real application, a fixed date should be set on when the new rule went into effect.

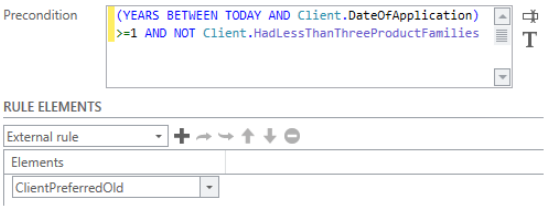

Figure 12: The rule group for old clients.

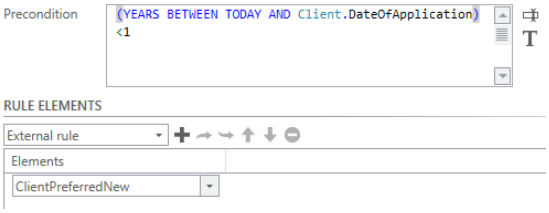

Figure 13: The rule group for new clients.

5 Discussion of Specific Interpretations

As is unavoidable when creating a large document full of rules and using natural language, certain rules can be interpreted in multiple ways. This may lead to deviating results between different parties that try to solve this challenge. The intention of this section is to discuss all rules we found in which multiple interpretations are possible and describe our choices for these, so that our results are as reproducible as possible.

5.1 Potential Occupant Injury Rating

The following two rules are not mutually exclusive:

- If the car has driver, front passenger and side panel air bags, then the cars potential occupant injury is low.
- If the car is a convertible and has no roll bar, then the potential occupant injury is extremely high.

We implemented these rules literally, and if both rules are fired, Blueriq's rule engine will indicate that these rules contradict in an error message. The scenarios that are chosen as part of this challenge do not trigger this contradiction.

5.2 Client eligibility

Rule 1 contradicts Rules 2 and 3:

1. If a long term client, the client is always eligible for auto insurance, as is every person and car directly covered by a long term clients auto policy.
2. If eligibility score is between 100 and 250 inclusive, then the clients application/policy renewal must be reviewed by underwriting manager who will determine whether the client is eligible for auto insurance.
3. If eligibility score is greater than 250, the client is not eligible for auto insurance.

We chose to give Rule 1 priority over Rules 2 and 3. This means that if it is a long term client, he is always eligible, independent of the eligibility score.

5.3 Airbag Discount

Consider the set of following rules:

1. If the car only has Driver airbags then lower the premium by 12%.
2. If the car has Driver and Passenger airbags then lower the premium by 15%.
3. If the car has Driver, Passenger and Side airbags then lower the premium by 18%.
4. If the car's potential theft rating is high and the car is equipped with an alarm system, then lower the premium by 10%.
5. Percentages are accumulated. Add up all the percentages that apply to the car and apply as a total discount.

If we read these rules literally, a car with all three types of airbag receives 33% discount, as both Rules 2 and 3 are applicable and discounts are accumulated. As this seemed rather unlikely to us, we decided that the only discounts that are accumulated are the airbag score, and the potential theft rating score, giving a maximum discount of 28%.

5.4 Alarm system

Consider the following rule:

- If the car's potential theft rating is high and the car is equipped with an alarm system, then lower the premium by 10%.

What happens if we add an alarm system to a car that does not have a high theft rating? Do we then still apply the discount? We chose to follow this rule literally, and only apply the discount if the car has a high theft rating and an alarm system.

5.5 Typical Driver

The following rules are stated in the assignment, but do not really add much to the case:

- Driver is a Typical Driver is all of the following are true:
  - Not a Young Driver
  - Not a Senior Driver
- If a Typical Driver, then increase premium by $0.

We just set a default value of 0 to the premium increase attribute, and only change it if the other cases apply. We did introduce the concept of a *typical driver* in the model, but it is not used in the logic.

5.6 The premium of the client

It is not stated explicitly in the case description, but we assume that the premium that the client pays equals the sum of the premium for all insured drivers plus the premium of all insured cars.

6 Scenarios

This section aims at showing the outcomes of the scenarios. We also discuss unclear points in the description of the scenarios for which we had to make choices to improve the reproducibility of our results.

6.1 Preferred Client Business Rule V1

We start by filling in the cars for the first scenario, starting with the 2005 Honda Odyssey, shown in Figure 14. The input values are shown on the left, the derived values on the right. There is no information whether this car has a roll bar or is a convertible. The data for the second car is shown in Figure 15. Here we also assume that when no information is given, the car does not have it (e.g., alarm).

Now we enter the drivers into the system, shown in Figures 16 and 17. There is no information on different driver trainings followed for Sara, so we assume none. For Spenser, the information is given that he has a "Good" Student Certificate. We could not find any information in the case what this exactly means or if this concerns a score (i.e., Good vs. Bad) or the validity (Valid vs. Invalid). We choose to ignore this.

Figure 18 shows the overview of the client. The conclusion of this application is that a premium of $ 2380.50 has to be paid to insure Sara and Spenser together with both cars.

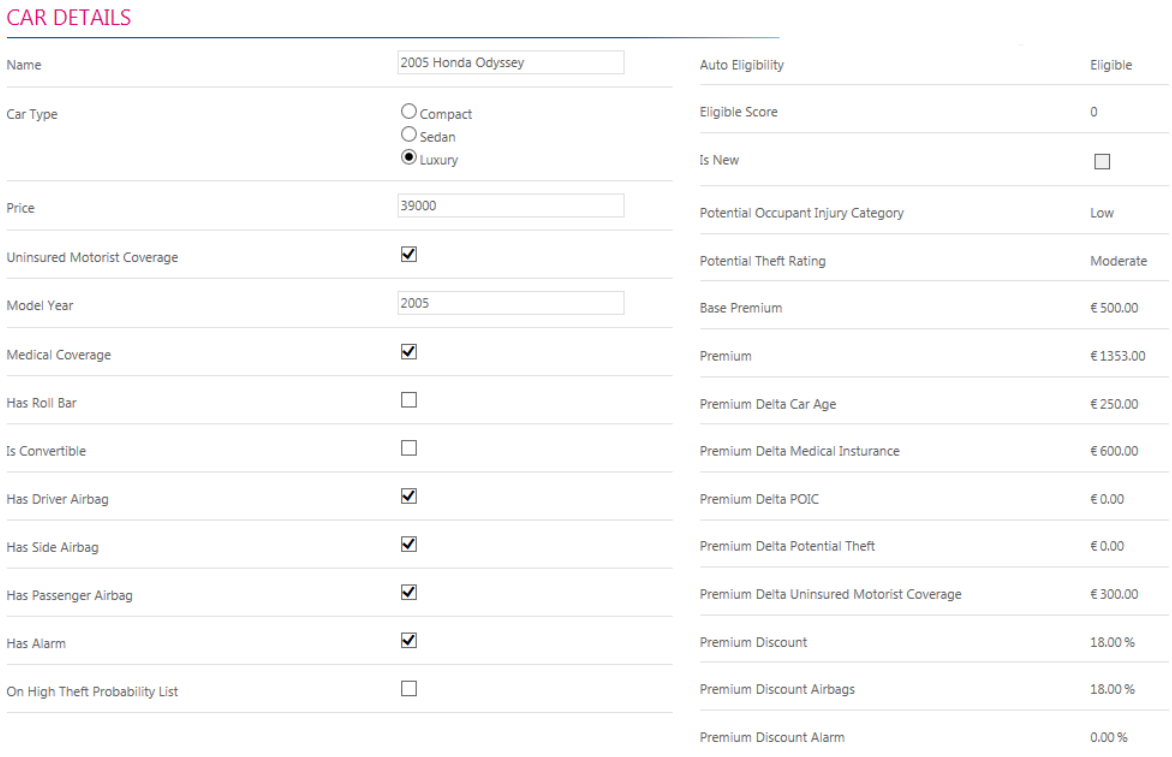

Figure 14: Data for the 2005 Honda Odyssey.

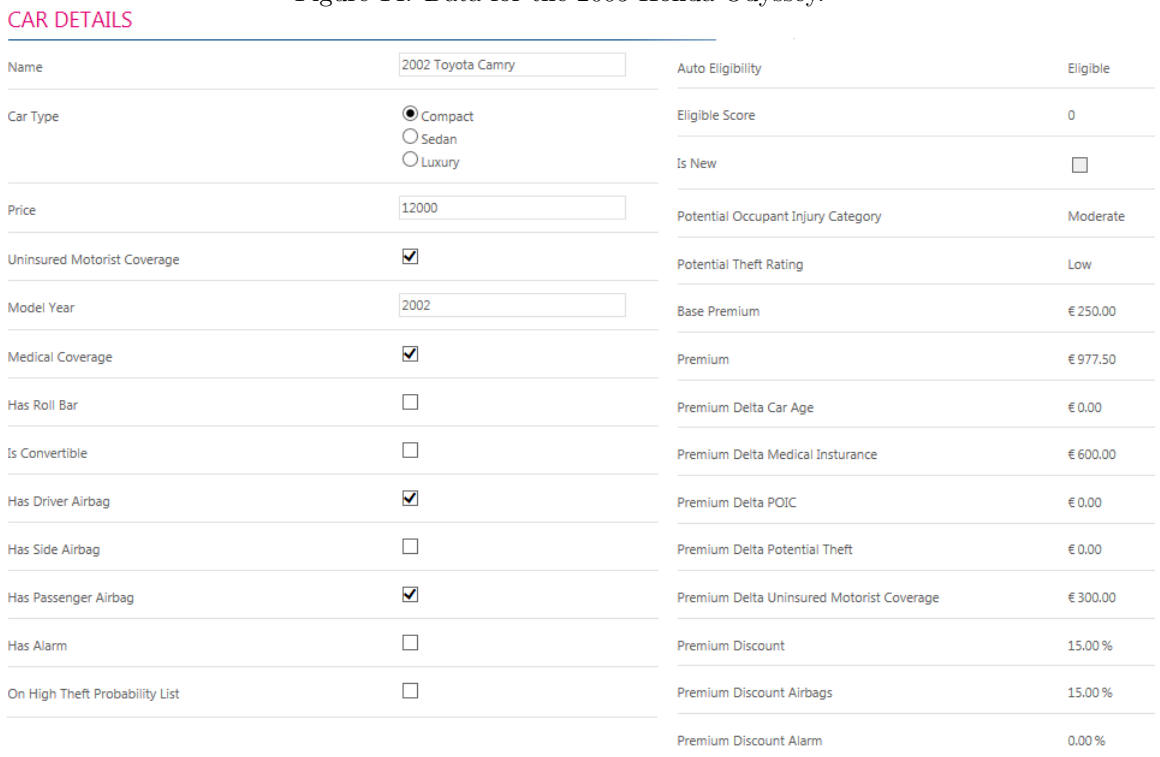

Figure 15: Data for the 2002 Toyota Camry.

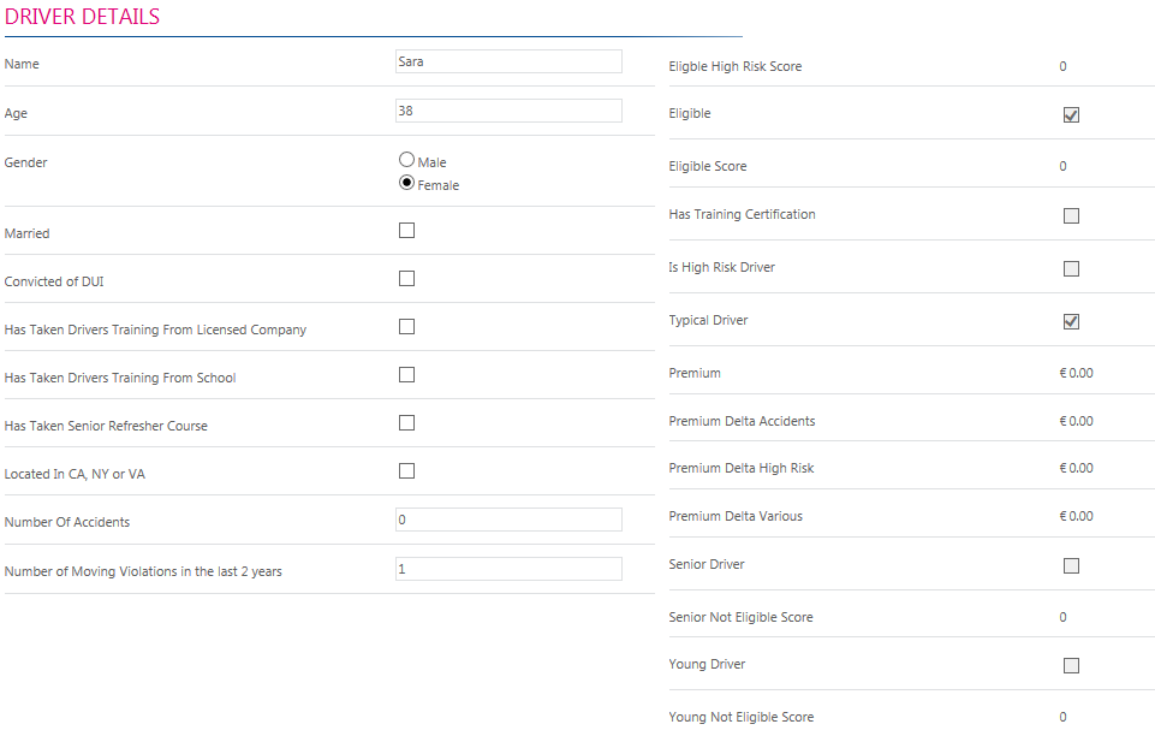

Figure 16: Data for Sara.

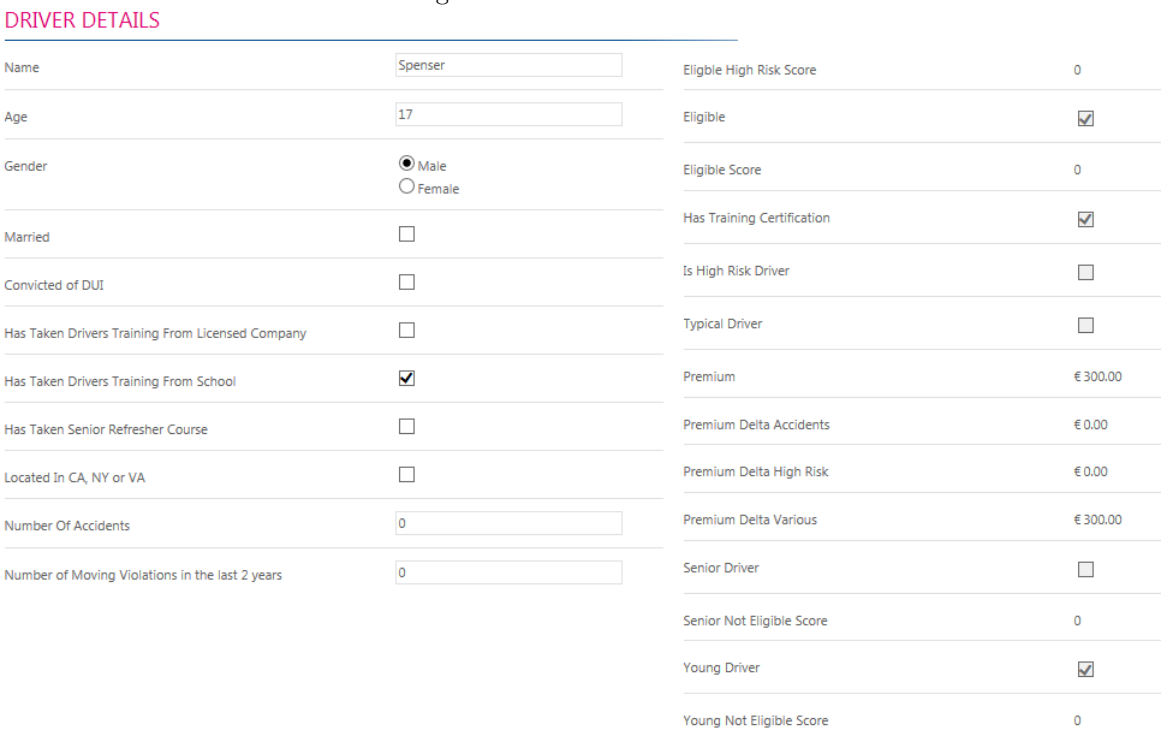

Figure 17: Data for Spenser.

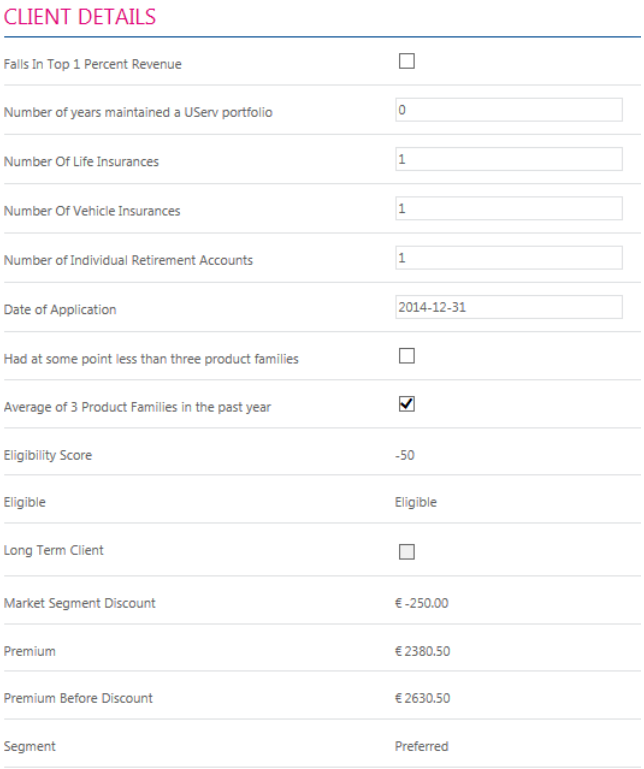

Figure 18: Overview of the client.

6.2 Preferred Client Business Rule V2

This scenario concerns the change in the policy for preferred client status, and compares Sara, which we already know from the first scenario, to a new client with the exact same data (except names and genders). As most of the data is similar to the previous data, we are only going to discuss the result in this section without showing all the details.

As Mark Houston is a new client and therefore has no average of three product families in the past year, he does not qualify to be a preferred client, and does not get a market segment discount of $ 250. He pays $ 2630.50 premium.

We are re-rating Sara who still falls under the old rules for the preferred client segment. This means that she still has the preferred client status, independent of her average in product families in the past year. Both cars are a year older. As our application computes the age of the car by comparing with the current date, we decreased the model year of both cars by one. This means crossing the threshold for rules concerning the age of the car.[3] The new premiums for the cars are shown in Figure 19. By comparing these number to the premium for both cars displayed in Figures 14 and 15, we see that the Honda Odyssey went down in premium due to the additional age. The new premium that Sara pays is $ 2425.50.

[3]This only holds if done in 2015. If you want to reproduce these results in 2016 or later, then the threshold was already crossed, and no change occurs.

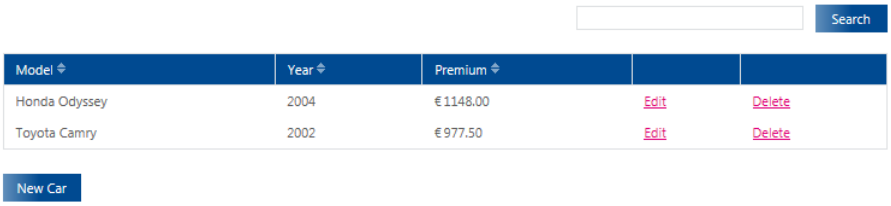

Figure 19: Sara's cars that are a year older.

6.3 Eligibility Within and Outside an Elite Client Relationship

This scenario concern Shane Meno, who is insured under his father's (Ray Meno) insurance policy. Ray Meno is a well known TV personality who has one of the largest car collections and has an elite client status. Shanes application overview is shown in Figure 20. The details for Shane as driver are shown in Figure 21, and the details for Shane's car are shown in Figure 22. Shane has to pay $ 2270 premium.

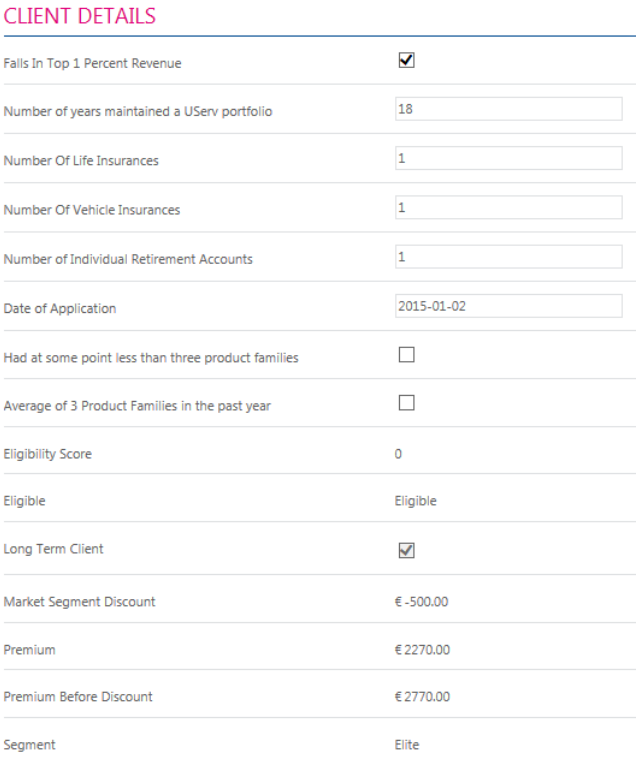

Figure 20: Shane's application.

We see that the eligibility score is 0. We are interested in how this value is computed, and Blueriq is able to create a decision requirements graph at run time that displays how the decision is taken using the actual values in the profile [3]. Figure 23 shows this run-time decision requirements graph for the eligibility score of Shane. We see that three factors influence this score, (1) the driver's score, (2) the car's score and (3) the client's score. In this case, the car's score of 100 is balanced with the clients score of -100, and the result is an eligibility score is 0.

DRIVER DETAILS

Name	Shane	Eligble High Risk Score	0
Age	21	Eligible	☑
Gender	◉ Male ○ Female	Eligible Score	0
Married	☐	Has Training Certification	☑
Convicted of DUI	☐	Is High Risk Driver	☐
Has Taken Drivers Training From Licensed Company	☐	Typical Driver	☐
Has Taken Drivers Training From School	☑	Premium	€ 1020.00
Has Taken Senior Refresher Course	☐	Premium Delta Accidents	€ 300.00
Located In CA, NY or VA	☑	Premium Delta High Risk	€ 0.00
Number Of Accidents	2	Premium Delta Various	€ 720.00
Number of Moving Violations in the last 2 years	3	Senior Driver	☐
		Senior Not Eligible Score	0
		Young Driver	☑
		Young Not Eligible Score	0

Figure 21: Shane's driver details.

CAR DETAILS

Name	1965 VW Bug	Auto Eligibility	Not Eligible
Car Type	◉ Compact ○ Sedan ○ Luxury	Eligible Score	100
		Is New	☐
Price	1500	Potential Occupant Injury Category	Extremely High
Uninsured Motorist Coverage	☐	Potential Theft Rating	High
Model Year	1965	Base Premium	€ 250.00
Medical Coverage	☐	Premium	€ 1750.00
Has Roll Bar	☐	Premium Delta Car Age	€ 0.00
Is Convertible	☑	Premium Delta Medical Insturance	€ 0.00
Has Driver Airbag	☐	Premium Delta POIC	€ 1000.00
Has Side Airbag	☐	Premium Delta Potential Theft	€ 500.00
Has Passenger Airbag	☐	Premium Delta Uninsured Motorist Coverage	€ 0.00
Has Alarm	☐	Premium Discount	0.00 %
On High Theft Probability List	☑	Premium Discount Airbags	0.00 %
		Premium Discount Alarm	0.00 %

Figure 22: Shane's car.

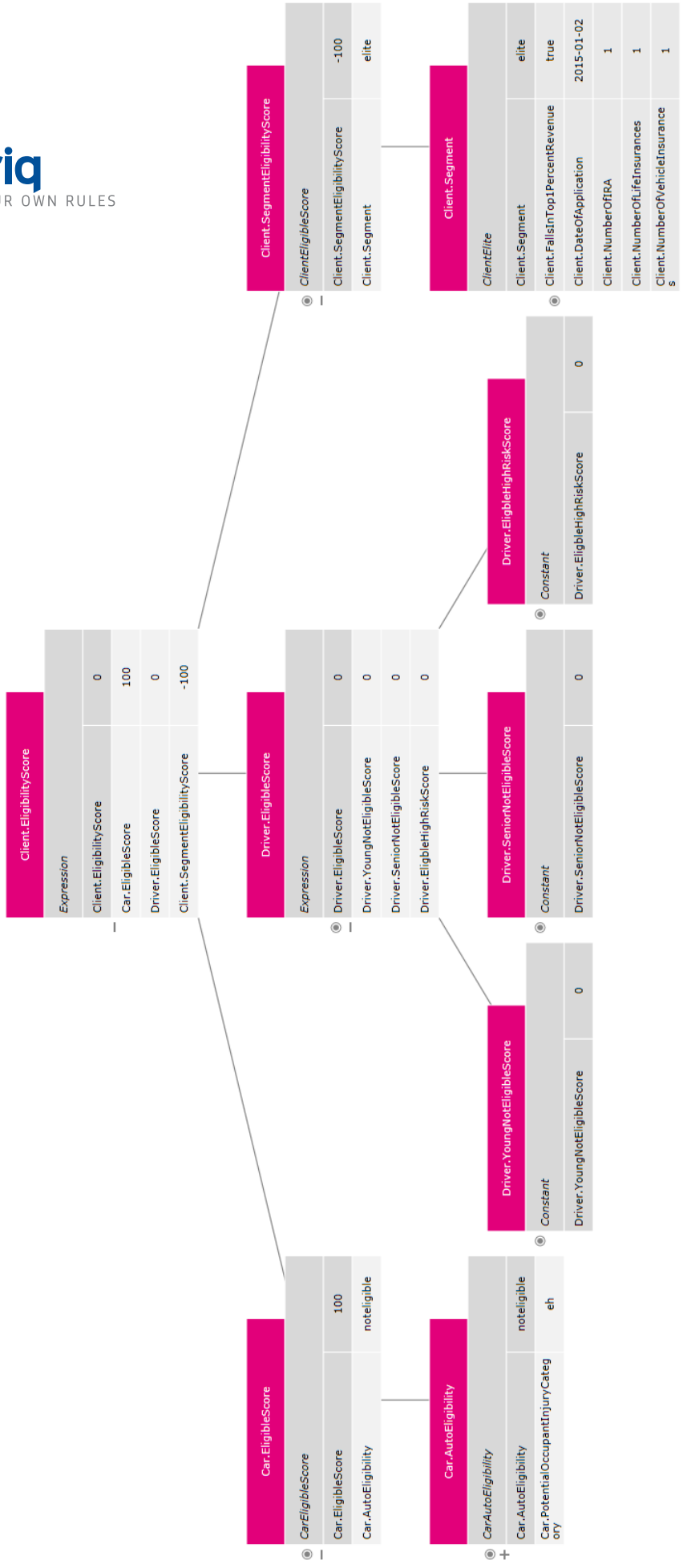

Figure 23: The run-time decision requirements graph explaining the eligibility score of Shane.

In the last part of the scenario, Shane marries and wants to apply for an insurance for himself and his wife. There are no details given for his wife in the description, so we decided to re-rate Shane outside his fathers portfolio without any additional driver, but with the information that he is married. Shane has now become part of the normal client segment. As his eligibility score is 100, his application has to be reviewed by the underwriting manager. If approved, Shane pays $ 2750 premium.

7 Conclusions

The use case of UServ Product Derby is an ideal playing field to demonstrate the strength of the Blueriq rule engine. Using the Blueriq studio, we are able to easily and accurately model all the business rules presented in the use case. Furthermore we are able to produce a decision rule graph that shows the dependencies of the business rules. This is valuable when trying to understand the decision that has to be taken, and to maintain it. At run time, Blueriq can take all necessary decisions that are involved when applying for an UServ insurance, and show a run-time decision rule graph to explain why this particular decision was taken.

Contact Us

If you have any questions about this article or if you would like to start a discussion, do not hesitate to contact us.

Email the author	:	m.schadd@blueriq.com
Email Blueriq	:	info@blueriq.com
Call Blueriq	:	+31 (0)73 6450467
Website Blueriq	:	http://www.blueriq.com

Blueriq BV
Veemarktkade 8
5222 AE s-Hertogenbosch
The Netherlands

About Blueriq

Blueriq is a rule-driven software platform designed to deliver dynamic business solutions for organizations with knowledge-intensive processes. It empowers organizations in fast changing environments to quickly and cost-effectively respond to changing business conditions and regulations. Blueriq provides solutions for Decision Management, Dynamic Case Management and intelligent User Experience Management across multiple channels. Solutions based on Blueriq are modelled, not programmed, giving you the opportunity to respond more quickly to your customers needs and improving your business outcomes. With Blueriq, you make your own rules!

References

[1] Decision Management Community. https://dmcommunity.wordpress.com/home/, 2014.

[2] UServ Product Derby Case Study. http://ai.ia.agh.edu.pl/wiki/_media/hekate:2005_product_derby.pdf, 2014.

[3] M. P. D. Schadd. Blueriq embraces the decision model. Technical report, Blueriq B.V., 2013. Available for download at http://www.blueriq.com/resources.